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OF THE
MYSORE
AGRICULTURAL &
EXPERIMENTAL
UNION

Vol. VIII]

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[No. 1

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To Our Members and Readers.

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The Entomological Section—By K. Kunhi Kannan, M.A., Ph.D.

The Mycological Section—By M. K. Venkata Rao, M.A., Ph.D.

The Botanical Section—By Venkata Rao K. Badami, L.Ag.

THE JOURNAL OF THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION.

A quarterly magazine devoted to the advancement of
Agriculture and published by the Mysore Agricultural and
Experimental Union.

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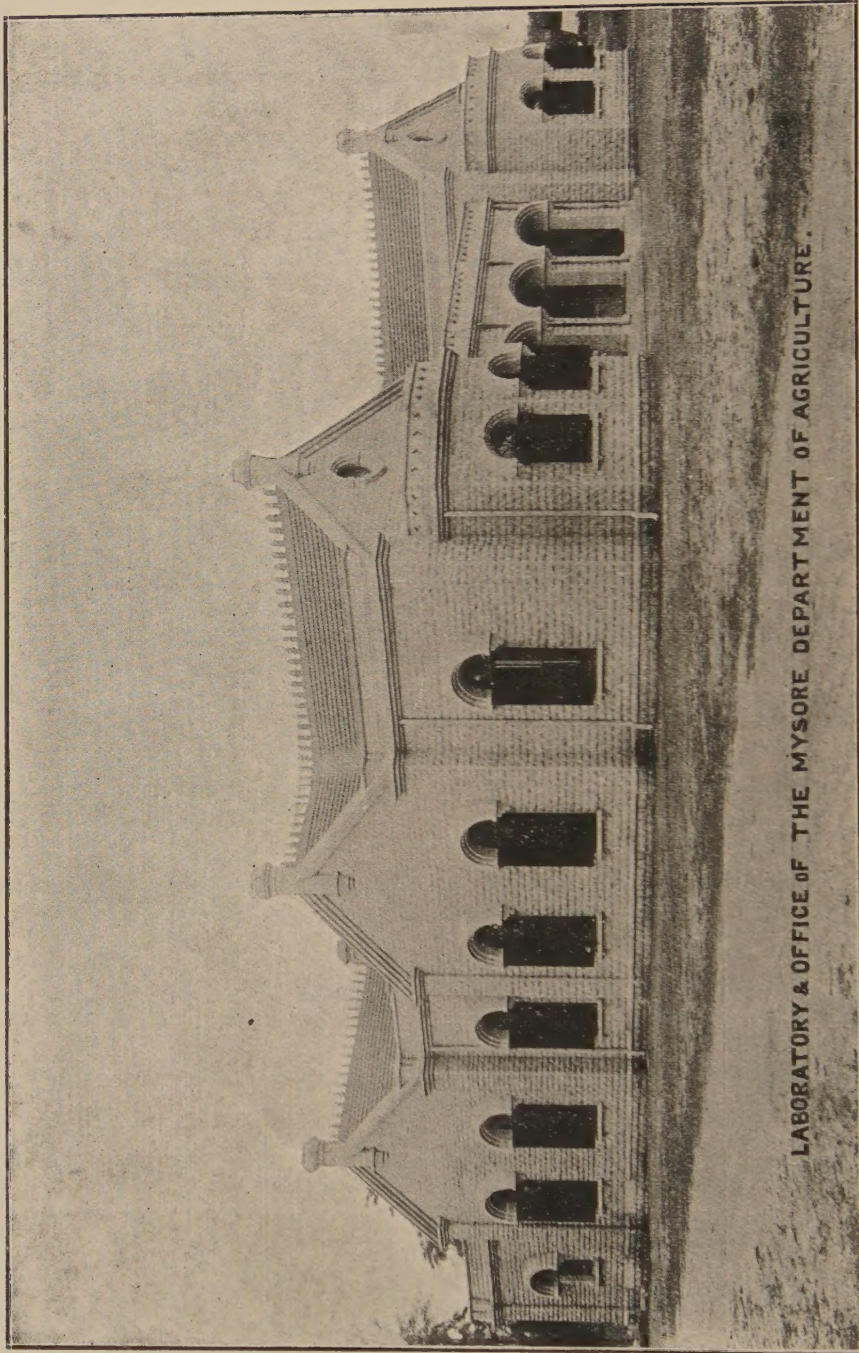
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LABORATORY & OFFICE OF THE MYSORE DEPARTMENT OF AGRICULTURE.

The Journal
of the
Mysore Agricultural
and
Experimental Union.

Vol. VIII.

1926.

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To Our Members and Readers.

It is now nearly twenty-eight years since the Department of Agriculture was started in Mysore with the appointment as Agricultural Chemist of Dr. Lehmann. Since then, the Department has grown by slow accretions to the present stage when almost all the activities associated with fully developed departments are covered by it. It might have been perhaps better to wait another two years before the results obtained by the Department are summarized; but opportunity having arisen recently of doing so, it would not be out of place if the members are acquainted with the results of the survey. The more important results alone are touched upon. The less important have been necessarily kept back from considerations of space. We hope the readers of the *Journal* will go over these reports carefully not only to know what has been accomplished in the past and what is promised for the future, but also to realize in all its ultimate bearings, the working of the policy the Department has set before itself from the beginning that it should concentrate its attention on work which yields the maximum results in the quickest time to the ryots for whose benefit it is created.

Chemical Section.

BY

B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist.

History.—This is the oldest section of the Department. In fact, the Department itself has developed out of the Department of Agricultural Chemistry started in 1899 with Dr. Lehmann as Agricultural Chemist. The laboratory of the Geological Department with its two assistants was put in his charge and all chemical work concentrated under him. For work in Agricultural Chemistry proper in the laboratory, the staff was strengthened by the appointment of another Assistant Chemist. In 1904, graduates were taken up for training in Analytical Chemistry, and out of these, two were appointed Probationary Assistant Chemists. The post of Agricultural Chemist was abolished in 1908 and work was continued by the assistants till the re-organization of the Department in 1914. During the period 1914-19, the staff consisted of—

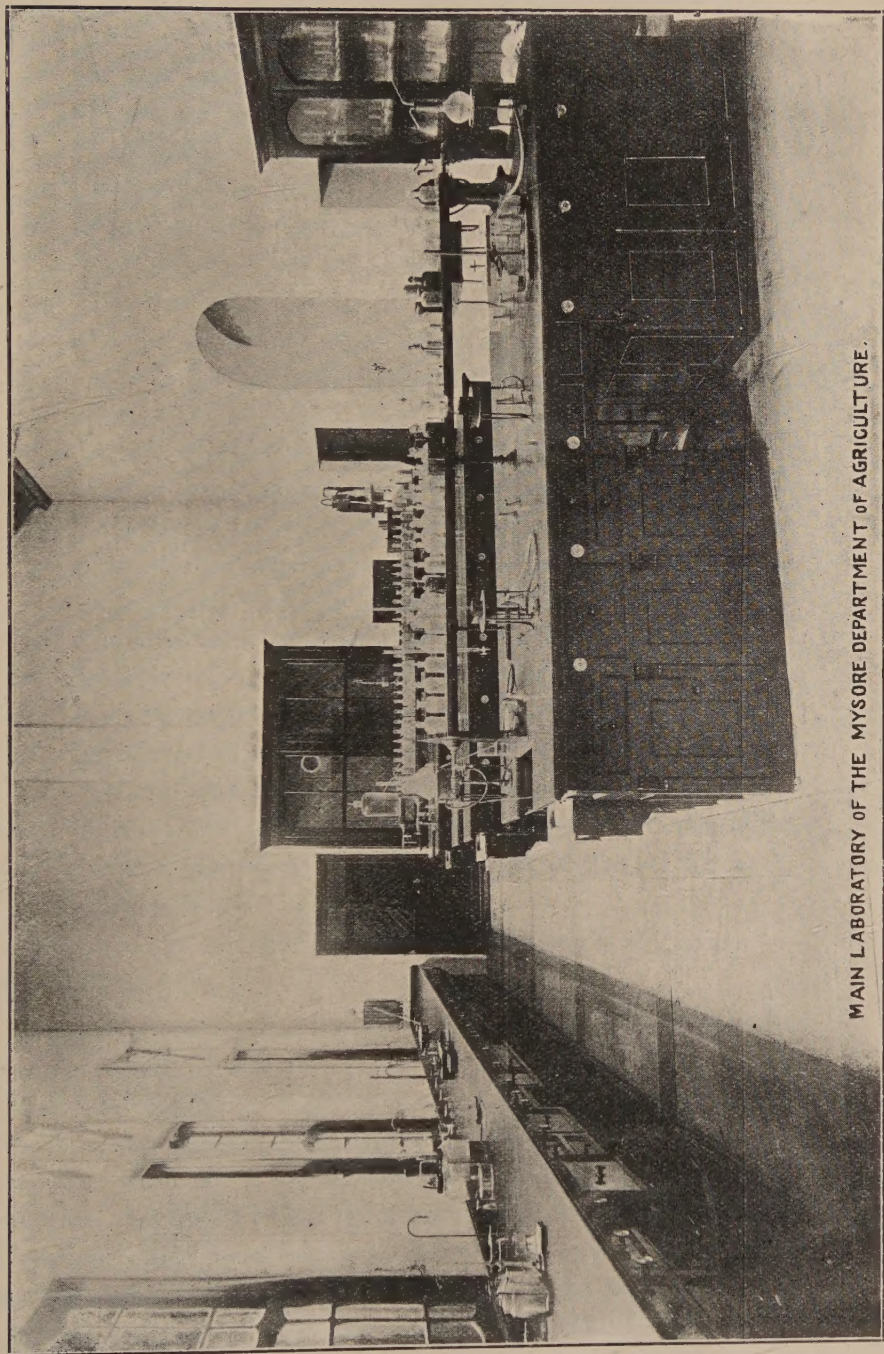
- 1 Chemist for Agricultural and Geological Departments and
- 3 Senior Assistant Chemists.

The appointment of Agricultural Chemist created again in 1914 was not filled up till 1919. Later on, the post of Chemist, Agricultural and Geological Departments, was abolished and the present staff consists of—

- 1 Agricultural Chemist,
- 2 Senior Assistant Chemists,
- 1 Senior Assistant Chemist on special duty for "Spike" work,
- 1 Junior Assistant Chemist,
- 3 Analysts and
- 2 Agricultural Inspectors, temporarily attached to the Section.

The present buildings were planned by Dr. Lehmann, and fitted up completely by 1902. Since then, there have been only a few additions and alterations to the laboratory buildings proper.

Investigations.—The first period of work of the section under Dr. Lehmann extends from 1899 to 1908. In addition to planning



MAIN LABORATORY OF THE MYSORE DEPARTMENT OF AGRICULTURE.

and fitting up of the laboratory, the following items of work were tackled :—

1. Manurial experiments with ragi and sugarcane in the laboratory compound.
2. Composition of juice from different varieties of sugarcane grown in the State.
3. Losses occurring during milling of cane and boiling of juice into jaggery under methods then in vogue.
4. Experiments on making raw sugar direct from juice.
5. The period of time which might elapse before cutting of cane in the fields and milling it before any decomposition sets in.
6. Analysis of coffee soils, methods of coffee cultivation and manurial experiments on a few estates.
7. Study of the factors which determine the quality of coffee.
8. Study of variations in the composition of fertilizers on the market with a view to the introduction of a Fertilizer Act.
9. Nutritive value of various famine foods in the State.
10. Studies of movements of soil moisture in red soils.
11. Pot cultures on the decomposition of bone-meal.
12. Laying out the Hebbal Farm and standardization of plots for experiments on ragi, paddy and sugarcane.
13. Planning out seasonal, cultural, rotation and manuring experiments with ragi, paddy and sugarcane on the Hebbal Farm.

The results obtained during the above period may briefly be summarized as follows :—

Of the varieties of sugarcane grown in the Province, the *pattapatti* or the striped one was found to be the best, yielding a very rich and pure juice containing over 20% of sucrose and less than 0.5% of glucose in it, and which keeps uniform in composition for about three months after ripening. Investigations into local practices of milling showed that, that fully $\frac{1}{4}$ to $\frac{1}{3}$ of the quantity of juice contained in the cane was left behind in the begasse or refuse from the mill. This led to the introduction of a new type of cattle mill—the Nahan mill of the Punjab—for the small land-owners and a power mill from Glasgow for large sugarcane growers like Mr. N. Krishna Iyengar of Oorga-

halli. The losses taking place during boiling of juice into jaggory were also found to be considerable, chiefly due to want of adding sufficient lime to the juice to prevent inversion during boiling. With the addition of a small centrifugal to the ordinary jaggory boiling outfit and boiling the juice into massecuite instead of into jaggory, it was found quite possible to manufacture fairly white raw sugar fit for direct consumption. It was also found best to mill the cane as soon as it was cut and boil the juice as soon as it was milled, observing scrupulous cleanliness in all operations of the mill house and using metallic vessels instead of earthenware pots for storing the juice.

Laboratory work on the factors which determine the quality of coffee indicated that specific gravity of the bean was the only reliable index for the present. The manurial experiments started were not continued long enough to get any definite results. On the cultivation side, it was not found necessary to dig the soil in the estates often and a system of maintaining leaf mulch was encouraged, which has subsequently proved very beneficial, to coffee estates.

The data obtained with regard to variation in composition of fertilizers on the market was put before the Board of Agriculture in India, but did not lead to the passing of any Fertilizer Act.

After the retirement of Dr. Lehmann in 1908, the items of work attended to by the section till September, 1919, when the appointment of Agricultural Chemist was again filled up, were the following :—

1. Analytical work connected with green manuring experiments on ragi on the Hebbal Farm.
2. Analytical work connected with seasonal planting of sugar-cane on the Hebbal Farm.
3. Jaggory vs. sugar-making experiments on a large scale on the Oorgahalli Estate.
4. Influence of flowering of cane on the quality and quantity of cane juice.
5. Composition of green manures used for paddy in the Mysore District and a study of the local practices of manuring paddy.
6. Continuation of work on movements of soil water.
7. Composition of typical soils from the Mysore District and areca garden soils from Shimoga and Kadur Districts.



OLD POT-CULTURE HOUSE
with wire-net enclosure attached

8. Utilization of nitrogen added in the form of green manures to red soils under dry cultivation.
9. Composition of samples of cattle manure from various parts of Bangalore District.
10. Influence of various quantities of lime added to sugarcane juice on the keeping quality of jaggory made from it.
11. Preparation of exhibits to the Annual Dasara Exhibition at Mysore.
12. Collection of samples of soil from all Government Farms for future work.

The results obtained during this period may briefly be summarized thus :—

Of the green manures used for ragi, black gram is very rich in nitrogen, but gives a very small amount of green material. So far as bulk is concerned, sunnhemp is about the best, but it is not rich enough in nitrogen.

The results of the effects of the various green manures on the yield of ragi are published in the bulletin on “Ragi Cultivation in Mysore”.

The season of planting sugarcane has a great influence not only on the yield of cane, but also on the quality of juice obtained from it. The results on the Hebbal Farm show that cane may be planted from November to March or April, without in any way affecting yields and quality of juice seriously.

Experiments on jaggory *vs.* sugar-making conducted on the Oorgahalli Estate showed that to compete with sugar from foreign countries, it is quite necessary to have up-to-date appliances even though we have a very rich cane like the *pattapatti*. With the addition of a centrifugal to the ordinary jaggory boiling outfit, it is quite possible to produce good crystalline raw sugar, but the process is a very wasteful one and does not pay so long as there is not much difference in price between sugar and jaggory.

Flowering of cane is no doubt an indication of approaching ripeness. Investigation on four different varieties of cane grown under similar conditions at Oorgahalli showed that, though juice from flowered canes is of a better quality than the same from canes which have not yet flowered, yet, there need be no undue haste to cut and

mill the cane soon after it has flowered. The quality goes on improving for about three months even after flowering without any loss in yield.

An investigation into local practices of green manuring of paddy in Mysore District was made and the results were embodied in a bulletin and published.

It was found that only a part of the nitrogen added to the soil in the form of green manures is utilized by a dry crop like ragi and that the addition of lime to help nitrification in the soil did not have the desired effect in enhancing the utilization of green manure nitrogen.

We now come to the third period in the History of the Section. The appointment of the Agricultural Chemist created again in 1914 was duly filled up on 1st September, 1919. The items of work being attended to since then are :—

I. Pot Experiments.—

1. Water requirements of ragi, jola and sunnhemp.
2. Availability of indigenous oil-cakes as compared with nitrate of soda and sulphate of ammonia.
3. Availability of phosphatic manures in red soils rich in iron and alumina.
4. Factors influencing the availability of phosphoric acid in bone-meal.
5. Manurial requirements of red soils with reference to ragi, jola and cotton.
6. Manurial requirements of black soils with reference to jola and cotton.
7. Manurial requirements of paddy and value of various paddy mixtures.
8. Influence of time of application of sulphate of ammonia on yield of ragi.
9. Availability of new nitrogenous manures like "FLORANID", and "CALCIUM CYANAMIDE" as compared with that of sulphate of ammonia and oil-cakes.

II. Field Experiments.—

1. Manurial requirements of the areca palm in the Malnad.
2. Influence of sulphate of ammonia on the tillering and growth of sugarcane.



NEW POT-CULTURE HOUSE
without wire-net enclosure

3. Manurial requirements of sugarcane under various conditions of soil and climate.

4. Manurial requirements of paddy in various paddy areas and trial of a few typical manure mixtures.

5. Trial of sulphate of ammonia and oil-cakes as a source of nitrogen for ragi crop.

6. Movements of soil water in black cotton soils.

7. Manurial requirements of coffee on the Coffee Experimental Station at Balehonnur.

8. Experiments with paddy and sugarcane on private lands.

III. *Animal Nutrition.*—

1. Variations in composition of milk from cows of different breeds and during various periods of lactation.

2. Value of wheat bran and groundnut cake as concentrated feeds for young stock.

3. Influence of wheat bran, rice bran and dhal husk on the quantity and quality of milk.

4. Production value and digestibility of certain concentrates along with roughage when fed to young stock of different breeds, carried out in co-operation with the Imperial Physiological Chemist.

IV. *Laboratory Work.*—

1. Analytical work connected with the above investigations.

2. Nutritive values of various indigenous fodder grasses.

3. Rate of nitrification of different oil-cakes.

4. Absorption of phosphoric acid by red, black and paddy soils and subsequent availability to plants of the phosphoric acid so absorbed.

5. Degree of acidity in various soils to find out their lime requirements.

6. Composition of typical Mysore soils.

V. *Investigation of "SPIKE" Disease of Sandal.*—

Since manures play a very important part in the increase of agricultural production, a large part of the work that is being done in the section since September, 1919, is in connection with the availability of various manures under local conditions of soil and climate and the manurial requirements of the principal types of soil in the State with reference to the crops grown on them. As a result of the above investigations and publication of the results obtained, the use

of artificial manures like sulphate of ammonia, superphosphate and potash salts is becoming more and more popular. The Department itself has been unable to meet the demand for sulphate of ammonia, and that item of work has now been handed over to a commercial firm which has opened its own depots in places recommended by the Department. As this section is not in charge of popularization of the results obtained by experiments on manures, a more detailed account of the gradual growth in the use of artificial manures will be found in the report of work in the districts by officers in charge of that work.

The results obtained till now may briefly be summarized as follows :—

Sulphate of ammonia applied to young cane about 8 or 10 weeks after planting and in doses of about 250 lbs. to the acre has a very good influence on the tillering and growth of sugarcane. An application of about 3 cwts. per acre of ordinary superphosphate just before planting cane in addition to the above dose of sulphate of ammonia and the usual dose of farm-yard manure has been found to act very beneficially on the yield and quality of jaggory as well.

Experiments on the manurial requirements of cane under various conditions of soil proved that, in addition to the above manures, an application of ground lime-stone at the rate of two tons per acre increased the yield of cane appreciably on laterite soils, but not on the ordinary red soils. Experiments on the Babboor Farm have shown that it is quite possible to grow a 30-ton crop of cane per acre using artificial manures in the area of the Vanivilas Sagar Tract.

Experiments on the manurial requirements of the areca palm in the Malnad have shown that in localities where, under the ordinary system of cultivation and manuring, the yield of areca is about 20 maunds or 560 lbs. per acre of 400 yielding trees, the yield can be increased to 30 maunds by the application of a mixture consisting of groundnut oil-cake, superphosphate and sulphate of potash. The most economic and profitable doses of these manures are being worked out now.

Experiments on the manurial requirements of red soils have shown that all soils respond readily to nitrogenous manures while only a few do so to phosphatic manures. A response to potash manuring seems to set in only after a couple of years of application of



PADDY EXPERIMENTS
in Bottomless Reinforced Concrete Frames

nitrogenous and phosphatic manures when the available supply of soil potash has become exhausted.

Work on the manurial requirements of black soils with reference to cotton and jola has indicated the usefulness of manuring the soil with nitrogen, phosphoric acid and potash. Field experiments in this direction also have just been started.

Experiments on the fixation of phosphoric acid by different soils have indicated that heavy soils like black soils and paddy soils easily fix the soluble phosphates added as manure while the ordinary red soil does not do so to the same extent. This has a practical bearing in determining the depth at which the phosphatic manures have to be applied in different soils so that they might not get fixed beyond the root range of ordinary crops.

Of the various paddy mixtures tried, those containing groundnut cake and superphosphate or castor cake and bone-meal have been found as effective as that containing sulphate of ammonia and superphosphate.

Experimental work on coffee manuring has just begun and so there are no results to report upon as yet.

Work on animal nutrition carried out in co-operation with the Live-Stock section on the Palace Dairy Farm at Rayanakere has indicated that a mixed ration of wheat bran and groundnut cake is very useful for young growing stock and that cake has some influence in hastening maturity in heifers. Experiments on milch cows have indicated that a mixture of concentrated feed containing a certain amount of rice bran in it, maintains milk yield better than one without it.

Work on investigation of spike, even though it has given some results of scientific value as basis for future work, has not yet yielded any results of economic importance.

Demonstration of results obtained.—The work of demonstrating results obtained by manurial experiments is in the hands of the district staff under the Deputy and Assistant Directors. When certain results have been obtained in the pot culture house and on Experimental Farms, those results are usually tested on private lands in selected localities before they are handed over to the district staff for demonstration work. The Members of the Agricultural and Experimental Union take a very active part in this kind of work.

Of the many trials conducted in this way on private lands, two instances deserve special mention as showing what scope there is for artificial manures in increasing food production and how an enterprising capitalistic landlord can help his tenants to grow more crops, thereby benefiting himself and his tenants as well.

One item of this work was in connection with paddy manuring in a locality under the Krishnaraja Sagara, where it is difficult to get either cattle manure or leaf manure. The experiment was made on 27 acres of land, all in one block, and cultivated by about a dozen tenants on "VARAM" or "SHARE" system. The average yield per acre before the application of artificial manures was about 235 seers of paddy per acre or 6,400 seers for the whole area. In 1924-25, the very first year of the application of artificials consisting of a mixture of oil-cake and superphosphate, the yield actually trebled itself and went up to 19,400 seers or nearly 720 seers per acre with corresponding increase of straw as well. During 1925-26, the total yield was 25,186 seers or nearly 933 seers per acre. The cost of manure applied per acre was about Rs. 20.

The second item of work relates to sugarcane experiments conducted on $9\frac{1}{2}$ acres of land near Bangalore, cultivated on the "VARAM" system by 33 ryots. In addition to the usual dose of farm-yard manure and oil-cake, the whole area had been manured with superphosphate at the rate of 350 lbs. to the acre and sulphate of ammonia at 250 lbs. to the acre. The yields in former years without the use of artificial manures used to vary between 150 to 250 maunds of jaggory per acre, whereas this year with the use of artificial manures as above, the yields varied between 280 to 450 maunds per acre and the average yield from the whole area was about 370 maunds to the acre. In all, there were 1,674 boilings and 32 gallons or 320 lbs. of juice was boiled at each charge, giving an average of 2.16 maunds of jaggory per pan.

These are two rare instances in which the Department has tried the results of experiments obtained on experimental farms on a large scale on private lands at the expense of the landlord himself. India is full of a large number of absentee landlords. If a large majority of them would take to the kind of work described above, they would not only be benefiting themselves and their tenants but appreciably increase the food production of the country as well.

Entomological Section.

BY

K. Kunhi Kannan, M.A., Ph.D.

Entomologist.

This Section of the Department was started in the year 1908 with the appointment of Dr. Coleman as Entomologist and Mycologist and an M.A. in Zoology as Assistant with two fieldmen and a laboratory-man. In 1911 an additional Assistant was appointed, in 1913 a teaching assistant. With the re-organization of the Department in 1914, Dr. Coleman was elevated to the position of the Director and the Entomological work was mainly under the direction of the Senior Assistant. In 1920 the latter was deputed to visit the important Entomological Laboratories of Egypt, Europe, the United States and Japan. In addition, he did entomological research in the Stanford University of California for which he was admitted to the degree of Ph.D. After return from deputation he was appointed as Entomologist. The section now consists of an Entomologist, two assistants, five fieldmen and one laboratory-man.

The staff being extremely limited, the section has had to concentrate its energies on the securing of results of immediate practical value to the ryots. The work of collection and identification of insect pests in general and the study of their life history has not been attempted. Pests are selected for study in the order of their importance and intensive investigation is undertaken till a remedy is found. In devising a remedy the aim is steadily kept in view that it should be simple and within the means of the poorest ryot. The abundance and cheapness of labour in the villages is not lost sight of. Except in regard to money crops such as coffee, an alternative to spraying is always sought.

The following remedies devised in the section will bear out the principles enunciated above. They are all of them original and for the first time recommended by this section. A brief account of the pest is added in each case.

Hairy Caterpillars (Amsacta albistriga Wlk).—A serious pest destroying the seedlings of most of the dry crops in three of the districts of the State. The caterpillars pupate in the fields themselves beyond

the reach of improved ploughs and the moths emerge after each shower of the first six weeks of the monsoon.

Remedy.—The moths which are white and sluggish are collected by village children and destroyed. Each female moth being capable of producing a thousand caterpillars, the collection effectually prevents the outbreak. (Original.)

The Rice Case Worm (Nymphula depunctalis).—A serious pest of rice in the Malnad parts of the State is amphibious. Advantage of the feature has been taken in the remedy which consists in placing a rag soaked in kerosene at the place where water enters the paddy field. The kerosene film so produced kills the caterpillars when they are distributed on to it. (Original.)

A Rutelid Beetle in Cane and Paddy.—This beetle being also amphibious—a fact noted for the first time in this group—the remedy described for the rice case worm has been found to answer well.

Ground Beetles (Gonocephalum homanseggi).—The larvæ of these are root feeders of several cereals and potato and cause serious damage in certain years. Fresh roots of grasses pulled out are placed about the field and the adults attracted are gathered and killed. This attraction to roots has been recently confirmed by investigators in Russia of an allied species. (Original.)

Pulse Beetles.—These attack stored pulses and cause serious damage. It was found for the first time that adults come to the top surface of the bin for purposes of copulation and egg laying. A layer of sand one inch thick on top of the seeds will allow the beetles to pass to the surface but they fail to get back to the seeds and so die without laying eggs. The pulses are thus saved. The withdrawal of the pulses is through a hole in the bin at the bottom. This remedy dispenses with fumigation with poisonous or inflammable chemicals. (Original.)

Sugarcane Borer. (Diatroca spp).—The caterpillars boring into young shoots are reached with difficulty. The moths have however been successfully attracted to small heaps of cane trash placed in the cane field which at the time of visit of the moths are usually bare of vegetation and afford few hiding places during the day. The moths are easily collected by children and destroyed. The collection has to continue for about two months and will not cost more than Rs. 2 per acre. (Original.) *International Sugar Journal.*



Sugarcane borer remedy—Catching moths hiding in the trash trap.

Lime Tree Borer (*Chelidonium cinctum*).—Adult beetles emerging in May, lay eggs in the fork of small twigs. The larva emerging girdles the twig to cut off the sap and then goes into the twig where it remains for a month or more before descending to the main tree. The girdled twig dries, is conspicuous and breaks off easily. The remedy consists in breaking off the twigs in time by means of a forked stick. The twig is caught in the fork of the stick and the stick given a sharp turn when it breaks off. (Original.)

The Orange Borer in Coorg considered for many years as a different species has been found to be identical with the lime tree borer and therefore susceptible to the same treatment.

The Rice Grass Hopper (*Heiroglyphus banian* Tal).—A pest on paddy and sugarcane in certain parts of the Malnad. The eggs are laid on the bunds in which the young remain for a few weeks. The insects are caught then in bags swept over the bunds. Cost about Rs. 4 per acre.

The Jola Grass Hopper.—(*Colemania sphenaroides* Bol).—A serious pest on jola and allied crops in certain parts of Shimoga and Chitaldrug Districts. The eggs laid in the fields and the young feed on the young crop. Grass hoppers caught in bags swept over the crop. Cost about Rs. 4 per acre.

Green Bug on Coffee (*Coccus colemani* Kann).—A serious pest of coffee in years of drought. Controlled by spraying fish oil resin soap when bugs begin to multiply.

The Avare Pod Borer (*Adisura atkinsoni*).—The caterpillar bores into pods of *Dolichos lablab* and causes damages estimated at several lakhs of rupees annually. The few moths which appear about the time the young pods appear on the crops lay eggs on them and so start the first generation. Village children rub off these eggs from the pods and kill the caterpillars twice at an interval of a week. Damage is thus very much reduced. (Original—Remedy not yet tested on a large scale.)

The Jola Ear Head Fly (*Contrarinia andropogonis* Flt).—These minute flies lay eggs in the developing grains of jola and so destroy them. A broad piece of cloth about 2 or 3 square yards covered with a mucilaginous substance is carried over as a canopy over the crop and the crop is shaken. The flies which usually oviposit in the mornings are then disturbed but on flying upwards are caught in

the mucilage and killed. (Original—Remedy not yet tested on a large scale.)

Coffee Borer (*Xylotrechus quadripes*).—A serious pest of coffee tunnelling the stems and causing damage extending to several lakhs of rupees in the State. Adults emerge during October to December and are easily caught by the hand. Children of estate coolies sent round in the afternoons are able to catch most of them. Damage is reduced considerably and the cost does not exceed Rs. 10 per acre. Remedy has stood the tests on three estates for three years. Not yet recommended for general adoption.

In addition to these the following pests are being investigated :—

Mango Hoppers (*Idiocerus* spp).—Life history work completed 12 years ago. Investigation continued to finding a simpler remedy than spraying.

The Rhinoceros Beetle (*Oryctes rhinoceros*).—Method of feeding ascertained for the first time. A remedy based on this information is being attempted. (Original.)

Epilachna on Potato (*Epilachna* 28—*punctata*).—Search for alternate host plants and for habits during intervals between crops being made to find a simpler method than spraying and dusting.

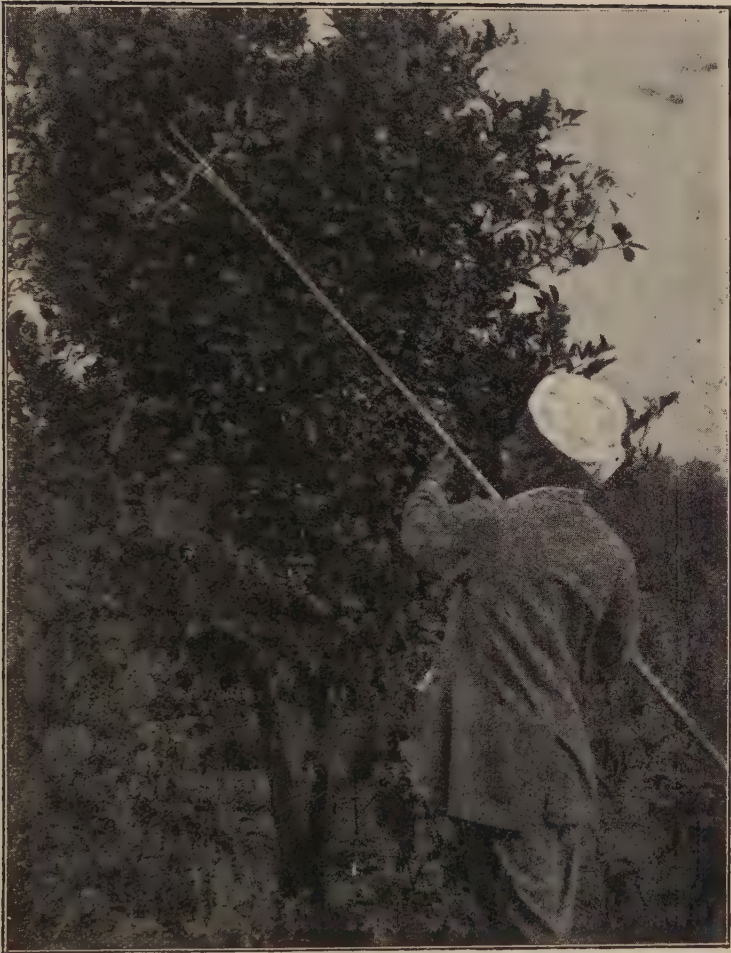
Cockchafer grubs.—Attacking sugarcane and other crops. The life history work has been completed.

Spraying is recommended in regard to other crops than money-crops only in cases of urgency and of limited areas. The fish oil resin soap now sold extensively by the Madras Fisheries Department all over India and Ceylon was prepared first at the instance of this section and according to the formula given by it. It was first tested and recommended for general use by this Section.

The following scientific results have been obtained :—

(1) The insecticidal property of mercury. Small quantities of mercury as $\frac{1}{2}$ a gram weight have been found to exert such an effect on the eggs of pulse beetles and certain other insects that their contents disintegrate and disappear. Results confirmed by investigations in the United States. (*Vide* 'Economic Entomology'.)

(2) The principle has been established that legless insects require purchase hold for penetration into hard material. (Subject for thesis for the Ph.D. Degree of the Entomologist.)



Lime tree borer remedy—Breaking off twigs containing the borer.

(3) The principle has been established that where in an insect the larva is soft-bodied and the body of the adult hard, the interposition of a screen of suitable mesh would prevent the return journey of the adult from pupal chamber. (Bull., Entomological Research.)

In addition, the following subjects of scientific interest are being investigated when time can be spared from other work of a more urgent character:—

1. The suctorial apparatus of Cicada.
2. Strepsiptera. (A group of interesting parasites on certain insects.)
3. A hypothesis in regard to protective resemblance.

Extension Work.—A great part of the energies of this Section is taken up in the demonstration of the remedies and in extensive campaigns. In addition to bulletins and circulars issued by this Section articles are prepared for the calendar, the *Union Journal* and for the Vernacular Press. The first poster on an insect pest to issue in India was from this Section. Where the remedies are exceedingly simple and require very little work and attention on the part of the ryot, they are demonstrated on the spot to carry conviction. Where continuous work extending over several villages is necessary and without co-operation satisfactory results cannot be obtained, the campaign is organized by the Section and carried out under the supervision of a responsible officer stationed in the area. A Pest Act has been considered necessary to secure the co-operation of the ryots. Regulations under the Act are drawn up with reference to the pest to be controlled. These are published in the *State Gazette* and copies in Kanarese are distributed among the villagers well in advance of the time when work is to be started. A brief account of the campaign against hairy caterpillars which have been carried on year after year for several years will illustrate the further procedure followed. A coloured chart illustrating the life history and the method of culture of the moths was printed and copies of it distributed to all villages and village schools. A circular in Kanarese has also been similarly distributed followed by copies of rules drawn up under the Pest Act. An officer tours in advance of the season in the villages to get the ryots to contribute towards expenses of the collection of moths and make the selection of fieldmen. A man is appointed for each village on a remuneration of Rs. 10 for the whole season. A block of severa

villages is in charge of a man on Rs. 15 a month. The staff is supervised by the officer who is stationed in the area. With the permission of the Inspector-General of Education, the schools in the locality are only held in the mornings, the children being thus free for picking work in the afternoon. The children are paid for the moths brought in at a rate varying from quarter anna to one anna per hundred. The fieldmen are paid by Government.

So far no prosecutions under the Act has been found necessary. The results of the work are so well appreciated that villages not taken up have applied for inclusion in the declared area. While the work is popular the time has not yet come when it may be left to the ryots themselves, for they are unanimously of the view that unless there is an officer to tour round to organize, stimulate and guide, the campaign will not receive from them the continuous attention it needs for good results. The campaigns against other pests like jola grass hopper, the rice grass hopper and the green bug of the coffee have been conducted more or less on similar lines.

Financial Aspect.—During the first few years of the Section the cost was not more than Rs. 10,000. In the course of 18 years of its existence the expenditure has increased to Rs. 20,000. The return to the ryot for whose benefit the Section exists is not easily estimated with any fair degree of accuracy for there are too many variable factors. It is determined with greater accuracy in regard to hairy caterpillars against which the campaign has been carried on for nearly a decade. The saving of crop from damage as a result of last season's work is rupees two and a half lakhs. The remedy against orange borer in Coorg is estimated to effect a saving annually of at least 6 lakhs.

Future Programme.—Work will continue on the same lines as in the past. The names of pests whose investigation is incomplete have been given. How many may be added to the list of pests to be studied will depend on the strength of the staff which is far short of the requirements of a State so pest-ridden as Mysore and on the facilities for rapid investigation which do not exist at present. The campaign against pests which takes so considerable a time of the staff will be left in the hands of the ryots themselves at the first opportunity. Every effort will be made to speed up the day by utilizing village panchayats to be created under the Panchayat Act. Money has been

sanctioned for developing Bee-keeping as a cottage industry and work will be taken on hand before the end of the year. The introduction of suitable plants yielding honey in areas where such are not found to exist or exist in insufficient numbers will be part of agricultural work. One such plant has already been introduced from America and has flowered for the first time. The testing of indigenous plants used as fish poison for insecticidal properties already begun will be continued. One plant has already been imported from abroad and is now being grown in the grounds of the laboratory. The popularization of a small hand sprayer simple in construction which the poor farmer may use against pests in their initial stages is also contemplated.

Mycological Section.

BY

M. K. Venkata Rao, M.A., Ph.D.,

Mycologist.

The Mycological Section was started in 1908 with Dr. Leslie C. Coleman as Mycologist and an Assistant Mycologist. When Dr. Coleman became Director of Agriculture in 1913, the charge of the section was left in the hands of the Assistant Mycologist whose designation was changed into Senior Assistant Mycologist. An additional Assistant was appointed in 1915 to assist in teaching work. The separate appointment of Mycologist was revived in 1923 and the present incumbent appointed to it. The present staff consists of a Mycologist, two assistant mycologists and four fieldmen.

From 1915-21, the Section had charge of the Marthur Farm for laying it out and developing as an Experimental Farm for investigation of arecanut diseases. Since 1924, the work of laying out and developing the Balehonnur Coffee Farm as an Experimental Farm for study of coffee diseases has been entrusted to this section.

INVESTIGATION.

1. *Original Work done and Remedies suggested.*—The work of outstanding merit has been (1) the discovery of the organism causing the Koleroga of Areca, and (2) the finding out of the life history of the fungus causing black rot of coffee including finding of additional hosts. Remedial measures advocated against both these have met with great success.

2. *Adaptation of work done elsewhere.*—Work in this consisted of studying (1) the life history of the smut on Jowar and comparing it with work done elsewhere and testing remedial measures used elsewhere, (2) studying the bacteria causing the ring disease in potato and confirming work done in the United States of America, (3) study of all the more important diseases of sugarcane for writing up a monograph on sugarcane.

3. *Work in Pure Science.*—(1) The study of the azotobacter and nitrate and nitrate bacteria in the Mysore soils was completed, (2) the discovery of bacteria in casuarina nodules, (3) gradual collection of herbarium material of the Phanerogamic and the Fungus Flora of Mysore, (4) finding out of additional species of *Phytophthora* and doing cross inoculations on same, (5) independent discovery of sclerotial stage of *Sclerotinia ricini*, (6) a disease due to *Rhizoctonia* on gingelly, potato, etc., was independently discovered here, (7) successful budding of plants belonging to different orders as Sandal, *Zizyphus*, etc., (8) disease due to *Thielaviopsis* on plantain was worked out in some detail, (9) study of the smut on ragi and *Cercospora* leaf spot on same crops, (10) discovery of yeast organisms in insects, (11) study of Phalloids, (12) study of ecological factors in Malnad flora was made and a paper read at the Indian Science Congress, (13) work of cultivating and studying entomogenous fungi.

4. *Work in various stages of completion.*—(1) Work on the *Anabe roga* of areca and cocoanut due to *Ganoderma lucidum* is being continued and remedial measures tried. (2) Work on the stump rot of coffee was partially completed and remedial measures also carried on. (3) Study of the Spike Disease of sandal including micro-chemistry of the tissues involved was done and the communicability of the disease through grafting and haustorial root-connections was definitely proved. A bulletin was issued, a conference held and articles contributed to the *Indian Forester*. (4) Investigations of leaf rust and die-back of coffee have been started.

INVESTIGATION.

1. *Trial of Methods at Government Cost.*—(1) Investigation of the use of Bordeaux mixture and powders on the diseases of crops was started. Spraying with Bordeaux mixture is being now done in co-operation with agriculturists of the State, The use of (1) different

adhesives, (2) of different strengths, (3) of different composition, and (4) in different physical forms, (5) in areas of different rain-fall is being continued in the Experimental Farm at Marthur and on lands of members of the Mysore Agricultural and Experimental Union.

(2) Use of soil disinfectants against root diseases of coffee and arecanut has been tried at various times but investigations are not complete.

(3) Successful control of abortion in broodmares which was due to ergot-infected fodder.

(4) Control of stem bleeding disease of cocoanuts by excision of affected parts and painting with hot tar has also been investigated.

(5) Rotation of crops to prevent the ring-disease of potatoes has been studied and demonstrated on the Farms.

Demonstration of known methods on large areas.—(1) Packets of weighed quantities of copper sulphate are prepared and sent over to the agricultural depots in the smut infected areas for sale to cultivators of Jowar crops together with instructions in vernacular for use.

(2) Progressively increasing sales of sprayers and materials for spraying with Bordeaux mixtures in diseases of areca and coffee have been kept up. The total material thus sold since the inception of this section is estimated at 100 tons of copper sulphate and other materials as lime, resin, soda *pro rata* and 2,300 pressure sprayers of one gallon capacity manufactured by Gebr. Holder & Co., of Metzingen, Germany, which was first introduced into India by this Department. Last season 6,600 acres of arecanut alone were brought under our methods of control and this area is scattered over a length of 90 miles and a width of 60 miles in one of the most inaccessible areas of the State.

(3) Progressively increasing use of casein as an adhesive in the preparation of Bordeaux mixture. The total casein thus sold within the last three years is 6 tons or material enough to treat 13,000 acres.

ORGANIZATION.

This Section directly supervises the field work through the Fieldmen permanently employed and local men temporarily engaged during seasons of stress. The season for spraying being short, large numbers are employed for short season only. The men are trained for the work and will be useful in their locality even when they are not in the service of the Depart-

ment. In addition to organizing co-operative spraying on large areas, partly by the introduction of the Pest Act, it has co-operated with the Madras and Bombay Agricultural Departments in introducing spraying in the areca gardens of North and South Canara and has been instrumental in supplying materials to both these administrations as well as a few co-operative societies. It has also to its credit the direct importing of material early in the season direct from manufacturers and stocking them in the stores in out-of-the-way villages where the cultivators can purchase sprayers, spraying materials and spare parts or have their sprayers tested and rectified. As the work develops in definite areas more and more work is being turned over to private individuals and co-operative societies.

INSTRUCTION.

Higher Instruction.—(a) Instruction has been given since 1913 in General Botany and Mycology to the students of the Agricultural School.

Short Courses.—(b) Short courses for the benefit of farmers was given in the vernacular on the Marthur Farm on special subjects as the use of the improved plough, the use of green manure crops, spraying against diseases, preparation of jaggory and use of silos for ensilage, etc.

Lectures accompanied by Lantern Slides.—(c) Lantern lectures were given at selected places in the affected areas on the development of the "Koleroga" disease and methods of successfully combating the same.

Exhibitions.—(d) Materials showing disease of common crops and methods of control were exhibited at the Dasara Mysore Agricultural and Industrial Exhibition and the Agricultural exhibitions organized by the District Boards and other public bodies.

Publications.—(e) Where methods of directly approaching the cultivators were found difficult, use has been made of the *Agricultural Calendar*, *Journal of the Mysore Agricultural and Experimental Union* and the local vernacular papers for writing popular articles on some aspects of Mycological work and technical and non-technical bulletins issued by the section.

FINANCIAL ASPECT.

The budget as it stood in 1908 when the work was started stood at Rs. 10,000 with a staff consisting of 2 officers and 2 fieldmen and

one laboratory man. The net savings due to the activities of this section for the subsequent 2 to 3 years or up to 1911 ranged roughly at about Rs. 10,000. The budget as it stands now is Rs. 20,000 with a staff consisting of 3 officers and 4 fieldmen and 2 laboratory men. The net savings due to the activities of the Department is estimated at Rs. 20 lakhs for last year alone.

Future Programme.—(1) In addition to completing works mentioned above which are partially investigated, work will be taken up on other diseases to which attention could not be given hitherto, for example the *Hidimundige roga* of areca which is suspected to be due to bacteria, premature dropping of arecanuts due to bacteria (?), *Anduodaka* or basal-cracking of arecanuts (a physiological disease ?); the black-bean disease of coffee, diseases of plantation and garden crops like pepper, cardamoms and apples which have hitherto received practically no attention.

(2) Completion of the material for the flora of Mysore and the local fungal flora will be attempted.

(3) More and more use will be made of the co-operative societies as agents for selling spraying materials and sprayers and giving such local help as they can.

(4) Advanced instruction in Mycology will be given to passed candidates of the Agricultural School who show a special aptitude for Mycological research.

(5) Plant breeding work for disease resistance with special reference to coffee will be taken up.

(6) Investigations of Phanerogamic parasites notably striga on cereals and sugarcane will be taken up.

(7) Such other work as may be decided upon at the Annual Departmental Conference will also be taken up as far as facilities permit.

Botanical Section.

BY

Venkata Rao K. Badami, L.Ag.,

Senior Assistant Botanist, Department of Agriculture.

The work of the Botanical Section comprises mostly of breeding work on the main crops of the State. The breeding work on ragi, sugarcane, groundnut and potatoes has been conducted on the Hebbal Farm. The breeding work on cotton and jola is carried on in the Babboor Farm. The laboratory work is conducted in the Central Laboratory of the Department.

A certain amount of testing of varieties, introduction of new crops and their trial was being done ever since the inception of the Department mostly on the Hebbal Farm in addition to the experiments on crop husbandry, in general. The outcome of these as far as the introduction of crops or varieties into general cultivation is concerned was the introduction of short season groundnuts and the Java and the Red Mauritius sugarcane. Previous experiments and tests conducted by the Department had clearly shown that the improvement of crops in Mysore could not be attained by a wholesale introduction of exotic varieties. Dr. Leslie C. Coleman sounded a note of warning in 1911 in the following words :—"The introduction of new varieties of seed from other parts of India has a very exaggerated importance in the minds of many. There are some who seem to consider it desirable to introduce promiscuously varieties from outside without any proper preliminary testing as to their suitability to local conditions. This would indeed be an extremely easy way to improve agricultural conditions, but unfortunately, like most easy and rapid methods, it is calculated, in the long run, to do more harm than good. At the same time it is extremely wasteful of time and money. It is necessary to sound this note of warning as the temptation to waste money and time in this way is very great, especially as there is perhaps no more convenient method of showing progress on paper than by enlarging upon a number of varieties that have been so introduced. It is, I believe, now pretty generally admitted that a much more certain method of improving crops is by seed and plant selections among varieties that are indigenous or that have long been grown in the State." All subsequent work is based on this clear enunciation of policy laid down by Dr. Coleman.

The work of systematic plant breeding by selection and other methods was commenced only from the year 1914 when the present Senior Assistant Botanist was appointed Assistant for Botany. He was later deputed to Cambridge to study plant breeding under Sir R. H. Biffen for two years, during which period he also visited the important Plant Breeding and Seed Improvement Stations in Sweden and Denmark.

The staff now comprises of the Senior Assistant Botanist, one Junior Assistant Botanist and three Agricultural Inspectors. The work of the section is described below :—

VARIETAL TESTS AND PLANT BREEDING.

1. *Hain ragi* varietal tests at Hebbal.
2. *Kar ragi* varietal tests at Mysore and Deboor.
3. Plant selections in *hain ragi*.
4. Collection of varieties from different *ragi* areas within the State and from other parts of India.
5. Sugarcane varietal tests.
6. Introduction of Indian and exotic canes.
7. Raising seedlings and selection work.
8. Groundnut varietal tests, spacing experiments and hybridization.
9. Cotton—collection of varieties, individual plant selections and hybridization, classification of Mysore cottons.
10. Preliminary work on Mysore castors and *avares*.
11. Seedling work in potatoes.
12. Methods of varietal tests—preliminary trials in the Districts and distribution of pedigree seeds ; conducting trials in the Districts on the fields of the members of the Agricultural and Experimental Union and collecting data from them prior to the general distribution of any seed in any locality.

The results obtained so far may be summarized as follows :—

Ragi.—(1) Of all the types of *ragis* introduced, the local type was found to be the highest yielder in this locality. Those having heavy heads seemed to suit moist conditions or rainy seasons. The small headed ones were found to tiller freely.

(2) In irrigated *ragis*, the continued selection of ear heads for seed purposes was found to result in heavy yields but it required selection in every season to keep up the strains.

(3) Most of the varieties were found mixed with others. Purified types gave higher yields and came uniformly to maturity resulting in the production of high grade seeds.

(4) Individual selections were made in large numbers. In later years selections were made in the fields alone in different parts of the State. Many selections were found to be superior to the varieties from which they were selected.

A large number of selections has been tested over five to eight years and many of them have been found to be superior to the local variety. Such ones have been multiplied, tested in various localities and distributed. The most popular ones are H22, H2, H13, H40 and H44. The Hebbal (No. 22) has been distributed very widely and it has now spread over a hundred thousand acres in the State. In many places, yields ranging from 20 per cent to 30 per cent more than the local yields have been obtained. Its drought resistance, heavy yield of good grain and a large amount of straw have made it a popular variety in the State.

(5) In *Kar ragi*, it was found that the violet open type was found to be the most prolific one. Some distribution of this seed has been made.

(6) Some garden *ragis* having very big heads have been evolved by selection. Four of such ones are being multiplied for distribution.

Sugarcane.—(1) In the varietal tests, it was found that Red Mauritius was the most vigorous and gave the highest yield of jaggery. But its juice was poor, containing less of cane-sugar and more of glucose. The jaggery was of an inferior kind having a reddish tinge and liable to run in the monsoons. B-208 was a cane rich in sugar, but its yields were quite disappointing. Java Mysore or Java cane acclimatized in Mysore is spreading in the western part of the State and J-33 A., another Java cane in the dry parts of the State.

(2) Cane seedling work was started in Coimbatore in 1911 and 1912 and plenty of material was collected in Mysore for that work in 1913. When it was found that the Mysore Plateau was congenial for

the cane to flower and set seed, evolving cane seedlings was started in 1913. While Coimbatore confined its activities to the evolution of canes for Northern India and hybridization work for combining desirable characters, Mysore confined itself to the evolution of thick tropical canes to suit the local conditions. All the exotic and indigenous canes of India were collected and the standard collection has been maintained all along. These consist of all the best known canes in the cane-growing countries. Many of them were found to flower freely and set seed between September and January. All of them were found to be hybrids and a good deal of segregation took place in the batches of seedlings. Advantage of this hybrid nature was taken in raising vast numbers of seedlings for selections. After methods were perfected for raising seedlings, the nature of seedlings from various parentage was studied. Some parents like B.208 produced rich canes without much vigor, whereas vigorous canes like Red Mauritius canes produced vigorous seedlings with rich canes and many desirable colours and other agricultural qualities. As a result of rigorous selection on morphological characters and chemical analysis of thousands of seedlings every year, many selections were made and tested for production. Seedlings like H.M.544, H.M.320, H.M.312, H.M.553, and H.M.315 have been very promising. Some of them have been tested in typical areas of the State for production and quality. H.M.544 has given even over 50 tons of canes per acre in several fertile tracts and H.M.320 is now competing with it both for yield and quality. This seedling work has a great future before it and several hundred acres are already under these Mysore seedlings within 6 years after their evolution.

In 1922, there was a general flowering of potatoes in Mysore and several varieties formed fruits. On examination it was found that the exotics formed seedless fruits owing to partial fertilization. Fertile seeds were found in the local variety. For the first time at least in South India, seedlings were raised in large numbers from the seeds obtained in the season. To raise disease-free seedlings a dry area was selected, a new well was sunk and the land brought under irrigation to plant the batch of 9,000 seedlings. About 4,000 of these formed small tubers. Early in 1923, they were all planted and found to grow into normal state, producing various kinds of tubers of all shapes, sizes and colours. Many of them had great vigor and

promised to raise the maximum yield of 350 maunds in the State at least to twice the quantity. There are now over 200 selections under observation and the work is quite hopeful. It seems quite possible to raise potatoes under Bangalore conditions to suit not only the Hill Stations, but also the hot but fertile plains of South India.

Cotton.---(1) The Mysore cottons were studied and classified in 1917. Those grown in the southern parts of the State were found to be *G. obtusifolium* (*Nadam*) and those grown in the cotton tracts in the northern districts to be *G. hirtaceum* (*Sannahatti*). *Sannahatti* was found to be a mixture of many types and very many strains were isolated for study. Some of them like the naked seeded ones were found to be highly heterozygous in nature. Some strains like those of Hiriya were found to be more productive than the Davangere cottons.

(2) In 1915, a large number of plant selections was made in the local *sannahatti*. They were studied for quality and ginning percentage in the laboratory. The best ones were grown in pure line cultures. Out of this work has been evolved two of Mysore's best selections, Nos. 69 and 45 which have very good ginning and spinning qualities. As to yield and vigor, they are equal if not superior to the local cottons. The area under these selections in the State is about 15,000 acres.

(3) A collection of exotic *hirsutum* and Indian cottons was made and tested at Babboor. The local Dharwar-American (*Doddahatti*) was susceptible to the red-leaf-blight disease. As the black cotton tracts in Mysore are restricted to a small area in the State, it was found necessary to evolve varieties out of *doddahatti* or strains similar to it to suit the red soils of Mysore if the area under cotton had to be increased. A large number of plant selections was made and some of them are promising.

(4) *Hybridization work*.—A large number of crosses made between the local cottons and the exotics were failures. Some of them set seed but they were ill developed or had no vitality to develop.

Some successful crosses between *G. hirsutum*s and *G. arboreum*s have been successfully made and the segregates are being studied now.

Crosses between tree cottons and *doddahatti* have been very successful. The segregates have been studied and selected up to the

fifth generation now and some of these are very promising. In the habit of their growth, size of bolls, ginning per cent, quality of lint and immunity to red-leaf-blight, they are highly satisfactory and quite promising,—especially, M.A. II, M.A. III and M.A. IV. Some of them have been already distributed to the cultivators.

Successful crosses have been also obtained between the Tree cotton $\times$ Trice, Tree cotton $\times$ Lone Star, Tree cotton $\times$ Cambodia, Tree cotton $\times$ Uganda. They are all under observation.

Groundnut.—Twelve varieties which are common on the market in India were under observation for several years. The spreading varieties were found to yield more than the bunch varieties but the latter were found to contain more oil. Closer planting in all cases gave more yield per acre. The optimum distance was found to be about 6 inches. The early bunch varieties are spreading in the northern districts where it is impossible to grow long duration ones. Groundnut after ragi in rotation was found to greatly increase the succeeding crop of ragi. Hence the spread of groundnut cultivation would not reduce the staple food grain supply in the State, but would on the other hand improve the fertility of the soil and provide the cultivator with ready cash to keep him free from indebtedness.

With a view to combine the desirable qualities in the bunch varieties and spreading varieties, crosses between the various types were made and the results have been highly successful.

(1) A natural cross between Spanish and Big Japan has resulted in the evolution of *H.G. No. 1*, one of hybrid origin. It is erect, vigorous, big podded, contains many seeds and ripens earlier than the spreading varieties. It resists drought very well and is highly resistant to leaf disease. The pods have all the commercial qualities required by the trade. It is now being multiplied for being distributed.

(2) Crosses between small Japan and Virginia have given many interesting segregates. Many new combinations have been formed and over 200 selections are now under observation. Some of them are very promising.

(3) Further work on the hybridization of groundnuts has been carried on. Over 25 combinations are now under observation. It is hoped to evolve superior kinds of groundnuts out of this work and the indications are quite encouraging.

Castors and avares.—A large collection of varieties is under observation and several types of castors have been distributed for preliminary trials.

Grasses.—Indigenous grasses have been isolated and grown in pure lines. They are being studied for their habit, yield and nutrient qualities.

A few exotic grasses also were secured from America. Out of these the Natal grass is promising and it has begun to run wild on the Farm.

A detailed study of the Legume *Sesbania-Aegyptica* was made. It was found to grow well under dry land conditions and could be cut several times a year. It is very nutritious and a very desirable fodder plant.

LABORATORY WORK.

Ragi.—(1) Fertilization of ragi flower was made in 1913. It was found to be a self-fertilized flower under Mysore conditions in most cases. The pollen grains were found germinated on the stigma long before the glumes opened. Discovery of this fact helped us greatly to start pure line selections in ragi.

(2) Methods of germinating pollen grains in moist chamber cells were discovered. This helped us to test the vitality of pollens of different varieties.

(3) Methods to induce the anther-sacs to emerge out of the glumes without bursting inside were found. By this it is possible to prevent self-fertilization and conduct hybridization. This method is hoped to be useful in breeding other small grained cereals.

(4) The root system of the crop also was studied.

Sugarcane.—Flowers of various varieties were studied to find out the fertile ones.

(2) Seeds were preserved for over six months and tested for germination.

(3) Methods of raising seedlings were evolved.

(4) Pollen grains were successfully germinated in moist chambers.

(5) Study of seedlings, their habit and the quality of juices were examined.

Cottons.—(1) Various methods were tested for germinating cotton pollen. None was successful.

(2) A method of germinating cotton pollen on castor oil drops in moist chambers was discovered. This would greatly help in testing the vitality of pollen grains in hybridization work. A partial drying of pollen grains seemed to increase the percentage and rapidity of pollen germination.

(3) Successful graftings were made both by approach grafting and tongue grafting to find out the effect of the root system of one variety over the other.

(4) Cytological study of the tree cottons and Mysore cottons is in progress.

Groundnuts.—(1) The groundnut plant has been studied in detail.

(2) Methods of hybridization were evolved.

(3) Breeding work was continued on a large scale.

(4) A detailed cytological study has been made. It has been found that the spreading types in general have 20 chromosomes and that the bunch types have 10 chromosomes. On this basis, the types have been classified into two different species, and in this species-crosses, probably owing to the disparity in the number of chromosomes, various combinations have taken place, giving rise to numerous segregates.

Cytological work on the behaviour of hybrids and other phases of chromosome behaviour in crosses are in progress.

DISTRICT WORK.

(1) Test plots were laid in the districts and varieties of ragi and sugarcane were tested over several years before the selected strains were handed over for general distribution.

(2) Selection of plants has been made in the fields in several localities.

(3) Varieties of paddy in the Malnad Farm were purified by roguing.

(4) Selected strains from the breeding plots were tested on the various Government farms.

INSTRUCTION.

(1) School work at Hebbal.—The senior students were trained in the elements of Economic Botany, Gardening and Plant Breeding.

(2) Demonstration work in the Districts and Taluk Conferences.

(3) Preparation of Exhibits for the "Industrial and Dasara Exhibition" and District and Taluk Exhibitions.

(4) Issuing of circulars in English and Kannada as to methods of selection and carrying out plot trials.

(5) Publication of popular articles in the calendars and the Union Journals.

FUTURE PROGRAMME.

(1) Evolution of new varieties of ragi, groundnut and sugarcane by hybridization.

(2) Improvement of potato cultivation by the production of disease-free seedling potatoes.

(3) Improvement of paddy in the Malnad and canal tracts.

(4) Cytological investigations on important tropical crops.

(5) Training of post-graduate students and research workers in Genetics and Plant Breeding in general.

SELECTIONS.

I

The Origin of Alkali Land.

BY ALBERT HOWARD, C.I.E., M.A.,

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In a recent review* of the agricultural investigations in India of the last twenty years, the idea was advanced that the origin of alkali land is closely bound up with defective soil-aeration. It was suggested that anærobic bacteria, by bringing about a reductive phase in the soil, are probably the real agents which give rise to the harmful salts which occur in alkali tracts. Several examples of the intense reduction which precedes the formation of these salts were quoted: In the alkali zone of North Bihar, wells have to be left open to the air otherwise the water is contaminated with sulphuretted hydrogen, thereby indicating a well-marked reductive phase in the deeper soil layers. In a sub-soil drainage experiment in the alkali lands of the Nira valley in Bombay, Mann and Tamhane† found that the salt water which ran out of these drains soon smelt strongly of sulphuretted hydrogen and a white deposit of sulphur was formed at the mouth of each drain, proving how strong were the reducing actions in this soil. Here the reductive phase in alkali formation was actually demonstrated.

After *Crop Production in India* was printed in 1924, the observations of Dr. Ferdinand Ossendowski, now Professor in the Military Academy of Warsaw and formerly in the service of the Imperial Russian Government, on the origin of salt water lakes have become available. Dr. Ossendowski was fortunate enough to observe vast colonies of reducing bacteria in lake Szira-Kul in Siberia and to record the intermediate stages between an ordinary fresh water lake and the reservoirs of dead salt water which occur in many parts of Asia. It is not unlikely that the transformation of a fresh water into a salt lake has much in common with the gradual alteration of fertile soil into dead alkali land and that these two things should be studied together as parts of a single problem.

In view of the urgent necessity for further work on the origin of alkali salts in the soils of Sind and North-West India, the following

* *Crop Production in India*, Oxford University Press, 1924, p. 43.

† *Bulletin 39, Department of Agriculture, Bombay*, 1910.

extracts from Dr. Ossendowski's latest work* appear to be worthy of attention:—

"The big lake Szira-Kul, which signifies "bitter lake," is situated between Bateni and the mountain range of Kizill-Kaya, quite near the latter's slopes. The lake is an oval, about 7 miles long and 3 miles wide, and lies in an unforested valley. At its north end reeds grow round the mouth of the small stream of fresh water which flows into it at this point. The lake is a reservoir of mineral, bitter, saltish water good for healing baths and efficacious in stomach diseases. A village with a small medical and bathing installation is situated on the eastern shore.

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"Taking from the bottom of the lake samples of ooze, black and cold, with a temperature never exceeding 34.6 degrees and always smelling of hydrogen sulphide, we remarked a strange phenomenon. After an exposure of some time in the open air, long, movable grasses of pale-yellow colour grew from this ooze, only to disappear soon without leaving any traces. It looked as though some being living in the ooze extended its feelers and then withdrew them. And really this was exactly what happened, as these were colonies of *Beggiatooe* bacilli, those precursors of the death of sea and lakes, which appear when some of the salts are decomposing and forming the hydrogen sulphide which kills all life in these reservoirs.

"Continuing our studies, we found at a certain distance below the surface an immense network formed of a great number of these colonies twined together, which rose up from the bottom gradually higher and higher, killing all symptoms of life. The lake was therefore quite dead, except that portion above the network wherein there still lived some diminutive crawfish, called *hammarus*, similar to ordinary shrimps but very small, being no more than one centimetre in length but as quick and bold as their sea relatives. However, the time will come when the quantity of hydrogen sulphide created by the *Beggiatooe* will also kill these last representatives of the former fauna of the lake and the process of dying in the lake will be ended as the bacilli themselves will in turn be poisoned by their own pernicious gas.

"Later on I studied with Professor Werigo the limanes near Odessa and some regions of the Black Sea. The identical process of dying was taking place here and after a longer or shorter period it will also even completely destroy the life of the Black Sea. The fish, sensing this process, are gradually leaving this sea, because they find in its depths these poisoned layers of water which are gradually rising towards the surface.

"This is the sad and gruesome process of the death of great water basins, which are metamorphosed into lifeless reservoirs of salt water

* *Man and Mystery in Asia*, London, 1924, p. 5.

smelling of hydrogen sulphide. The Dead Sea in Palestine has long since been such a reservoir, and great numbers of similar ones are scattered over the immense plains in Asia."—*The Agricultural Journal of India*, Vol. XX, Part VI, p. 461.

II

The Rural School.

We cannot emphasize too much in this bulletin that the prosperity, happiness and good living of any group of people depend largely on its level of intelligence, its understanding of its special problems. Because this is true, the rural school is the key to the building of a prosperous and satisfying rural life in Washington. The degraded farmer throughout the world has been an ignorant farmer. Knowledge means power, wealth, protection against exploitation by others, an appreciation of the values of a high standard of living and how to get a high standard of living, a feeling of pride in one's occupation, and the esteem of one's fellow-men. These are the factors that make life worthwhile. They should be the aim of the rural school. All classes and groups of people that have gorged ahead have done so on the basis of a high level of intelligence.

What should a rural community offer in the way of education to prepare its young people for this new day of the farmer? This can only be answered by first noting the social and economic setting of the rural community. A few pertinent facts must ever be kept in mind when we are proposing an efficient system of rural schools; (1) the farming class must have equal advantages in education with all other classes, including elementary, high school and college education; (2) since from one-half to two-thirds of all rural boys and girls will continue to live on the farms and in rural communities, it is necessary that the rural school course of study should specially fit them for living a good life in the country; (3) since rural children must become citizens with a broad general outlook, they should have the same broad cultural training that is given to urban children; (4) rural schools so far as possible should have well-trained teachers and efficient supervision; (5) the rural school plant should be frequently used by the entire population of the community; (6) the rural school should teach country people to get the very best out of life in the country.

When we begin to translate these general aims of the new rural education into concrete realities, it means that we must have (1) a nine months' school term; a well-equipped school plant with well lighted, well ventilated and well heated rooms, with library, teaching and laboratory equipment; a four-year high school within reach of every rural

boy and girl ; a school unit of sufficient size to make its administration and supervision economical ; (2) a rural school curriculum that gives a broad general background ; that trains for intelligent citizenship ; that trains for home-making on the farm ; that gives the prospective young farmer a knowledge of soils, farm crops, farm animals, farm machinery, farm management, farm buying and selling, and the advantages of co-operation ; that teaches the relationship of the farming class to other classes ; that teaches the country child how to find enjoyment and pleasure out of the study of the nature life in the community ; (3) professionally trained teachers who know and can use the best methods of instruction ; who understand the economic, social and physical setting of farm life, who are willing to make themselves active citizens in the life of the community and enter sympathetically and enthusiastically into its social life ; (4) a school plant centrally located, with auditorium, play room, and playground, a real social centre at which the whole community can gather for association, discussion, lectures, entertainment, play and recreation, and that affords opportunities for adult education ; (5) a sufficient number of college educated farmers, farm wives and farm leaders and experts, to think through the problems of the farmer and help him solve them.

As already pointed out, the new rural school is the key to the remaking of country life. Nothing will pay bigger returns to farmers in Washington than money invested in schools that prepare for an understanding and appreciation of farm life. With the rural school master lies much of the hope of the rural life of the future. If the rural school teachers of Washington can visualize in this generation what they would have the farm life of Washington be in the next and can construct and carry through their educational aims accordingly, then the next generation of country folk will come close to realizing the attractive farm life that this generation is talking so much about. The rural school and the rural school teacher can be the greatest force in making the future farm life of Washington.

The objection need not be made, as it is so often made by some people, that in establishing schools that prepare specially for farm life, many deserving boys and girls fitted for other occupations and aspiring to enter other fields, will be prevented from entering other callings. This need not be at all. It should always be kept in mind that from one-third to one-half of country boys and girls will enter other occupations. The best country schools, particularly the small town and rural high schools, have at least two courses of study, one of which gives such training as is needed to fit one for other callings than agriculture. There are many courses of study such as Civics, English, History, Science, Economics and Social Problems, that every boy and girl should study irrespective

of the vocation he or she will enter. These courses can be studied in common by boys and girls who will become farmers and farmers' wives and by those who will find their livelihood in some urban occupation. Only one-third or one-fourth of the new rural school curriculum needs to be especially concerned with the rural environment and its problems. Country boys and girls need the broad general scientific, cultural, and civic background just as much as urban children. It is not a narrow specialized education that rural children need but an education that prepares for living in a great national and international society as well as a rural society. Urban life and occupations are intricately woven into rural life and occupations. Cities, towns, villages, and country communities have a single economic, social, and political life together. No system of rural education must overlook this important fact.—*State College of Washington, Agricultural Experiment Station, Pullman, Washington*. Bulletin No. 195.

II

Crop Rotation—The Effect of One Crop on Another.

BY PROF. F. HARDY, M.A.

That continuous cropping of a soil by a plant species may result in diminished yields, has long been known to agriculturists. Hence, from the earliest times, rotation of crops has been practised in a more or less definite form to overcome this tendency. It was only in the early part of the nineteenth century, however, that the practice of crop rotation was generally accepted in well-established agricultural communities. Experience has subsequently accumulated to prove that, not only may one crop of a certain plant species adversely affect the growth of a following crop of the same species, but that one species may adversely affect even quite a different species if grown before it on the same soil.

Theories relating to the adverse mutual effects of crops.—Two chief theories have been evolved to account for these observations. The older theory maintained that plants excrete through their roots certain substances that exert varying degrees of toxicity on plants of the same or of different species grown in association with them, or planted after them. The root-excretion theory was urged mainly by de Candolle in his well-known book, *Physiologie Vegetale*, published in 1832 in Paris. It was based principally on the experiments of Macaire described in a memoir that was issued in the same year under the auspices of the Geneva Natural History Society. Macaire's experiments, which were mainly water-culture tests, were later severely criticized by numerous investigators who sought to prove that his results could just as well be explained in terms of

differences in amounts of nutrients absorbed by different plants whose roots possessed specific selective powers. One notices here the effect of Liebig's teachings, which held sway in the middle of the nineteenth century, and which have largely dominated field experimentation even to the present day. There can be no doubt that the supply of soil nutrients, such as nitrate, potash and phosphate, is one of the chief factors deciding crop yields. Nevertheless, the disagreement between authorities regarding the mode of action of fertilizers, and their failure to arrive at a satisfactory basis for generalization in the use of fertilizers, even after an enormous number of field trials, has led to a realization of the possible existence of other factors controlling soil productivity. Among these additional factors, soil toxins have again been suggested as a factor of great importance.

The newer theory of soil toxins differs from the older, or de Candolle's theory, in that it ascribes the source of toxins, not to root-excretions of living plants, but to plant-debris undergoing decay under certain definite soil conditions. The chief exponents of the newer theory were the Duke of Bedford and Pickering in England, and Ehrhney, Cameron, Livingston and Schreiner in the United States of America. Bedford and Pickering made some remarkable experiments at Woburn on the harmful effects of grass on the growth of fruit trees (1897-1914). The American investigators (1903-1915) found that certain unproductive soils, as well as their water extracts, contained substances toxic to plants, and that their toxicity could be reduced by adding certain types of organic matter, oxidizing agents and chemical salts, including common fertilizers. Indeed, Schreiner and his associates (1900-1913) actually succeeded in isolating from soils several organic compounds that were found to be markedly toxic to plants. From this work there followed a general theory of the mode of action of fertilizers and manures which was widely propagated in American textbooks of agronomy during the early years of the present century.

A recent extension of the soil toxin theory includes the deleterious action of soluble salts of certain metals, such as aluminium, iron and manganese, which appear in many instances to be casually related to soil acidity.

More recently still, plant parasitism has become recognized as an important factor in soil fertility. Parasitic micro-organisms are usually somewhat specific in their ability to attack higher plants, so that continuous cropping of the same or closely related species favours disease, and reduces crop yields. Nevertheless, parasitism alone hardly furnishes a sufficient basis for generalization regarding the reciprocal effects of crop plants. Furthermore, it is now known that certain soil micro-organisms, including protozoa, although not parasitic on higher plants, may actively destroy beneficial bacteria, and thus lower soil productivity.

Instances of harmful effects of one crop on another.—Many field experiments have demonstrated that one crop may specifically affect another. Daubeney (1845) at Oxford, England, was perhaps the first to study definite cases of such relationship. He grew barley, oats, beans, potatoes, clover and flax in continuous cropping or in definite rotation on small plots over a period of ten years. He found that rotations gave better yields than continuous cropping in most cases, but that in certain instances, the reverse appeared to obtain. Bedford and Pickering (1908) found that clover as well as grass may adversely affect the growth of apple trees, whereas weeds have lesser effect. They concluded that toxicity is not cumulative, but lasts only so long as the surface crop is growing, and may be lessened or annulled by adequate soil aeration. Certain varieties of apple trees were less affected than others. Bedford and Pickering reproduced many of their results by allowing the leachings from the surface crops, grown in perforated trays, to fall on to the soil surrounding the fruit trees. Hedrick (1905) in Utah made similar observations on the effects of cereals, vegetable and small-fruit crops on young peach trees. He found that oats and rye were more injurious than tomatoes, potatoes, mustard and rape but that beans and crimson clover exerted beneficial effects when grown near peach trees. Fletcher (1912) at Gizeh in Egypt demonstrated that maize greatly retarded the growth of sesame when planted in alternate rows, and that result was not affected by irrigating nor by fertilizing the soil. Skinner (1913) in California observed that cabbages did not grow well on peat soil that had previously grown sesame. A. Howard and G. L. C. Howard (1915) in Bihar, India, found that green manure crops must be turned in very early before satisfactory yields can be obtained with the tobacco crop planted afterwards. They also found that on heavy or water-logged soils, green manuring actually reduces the yield of tobacco, thus indicating the necessity of adequate soil aeration in tobacco culture. Hartwell and his co-workers (1919) at Rhode Island, U.S.A., found that the effects of various crops on those which followed were much reduced when the soil was limed to neutrality, and that they were not proportional to the quantities of plant nutrients removed from the soil. Sewell (1923) stated that it is a general observation that wheat does not give as high yields when grown after Kafir corn (*Andropogon sorghum*) as it does after Indian corn (*Zea mais*) in the Great Plains area of North America. Finally, Garner, Lunn and Brown have very recently (1925) demonstrated by precise experiments in Southern Maryland that the tobacco crop is especially sensitive to the effect of preceding crops. Many cropping systems were tested in attempts to obtain the highest possible yields of tobacco, but none of them was so beneficial as a continued previous resting condition, whereby the land was occupied for several years by natural adventitious vegetation. The use of soil-improving crops, including rotation grasses combined with liming, but without

the addition of fertilizers, resulted in practical failure of the tobacco crop. Certain preliminary tests indicated that the injurious effects of preceding crops on tobacco were derived from root-residues rather than from tops of the crop plants.

CONCLUSION.

Conclusions.—The diverse and often unexpected results which follow when one crop is grown after another, should teach caution in the selection of plants to be grown in rotation. Generalizations based on experience with one particular crop plant or type (such as cereals), should not be applied indiscriminately to others. Even rotation legumes may not always exert the beneficial effects usually expected of them. Recommendations as to rotations to be practised should not be made by field officers unless adequately supported by precise and long-continued experiments. The effects of soil aeration and of climatic fluctuations appear to be especially significant in deciding the results of crop rotations, and even soil acidity may in certain cases be a controlling factor.—*Journal of the Imperial College of Tropical Agriculture*, Vol. III, No. 7.

IV

The Fodder Problem in Its Relation to Cattle-Breeding.

BY D. CLOUSTON, C.I.E., M.A., D.Sc.,

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At the tenth session of the Indian Science Congress held at Lucknow in 1923, a joint meeting to discuss ways and means of improving the supply of fodder and forage in India was arranged by the Presidents of the Sections of Agriculture and Botany. The papers read at this joint meeting were afterwards published as one of the bulletins of the Agricultural Research Institute, Pusa. This bulletin, No. 150 of the Pusa series, is well worth perusal, giving as it does a general survey of the wider aspects of the fodder question in different parts of India.

Efforts are being made on Government farms in several provinces in India to improve the local breeds of cattle by selective breeding and cross-breeding. It is everywhere felt, however, that any improvement of our breeds must be preceded by an improvement of the fodder supply; for in the realm of animal husbandry better feeding is just as important a factor as better breeding. The fodder question in this country is largely one of economics. The bulk of the cultivators are small men, each cultivating an area of only a few acres, no part of which is ordinarily set aside for the cultivation of fodder crops only. His cattle are grazed on the waste lands and grazing grounds common to the whole village where the

pasture available is poor in quality and very limited in quantity. In addition to the food they pick up on these pasture lands so called, draught bullocks and cows kept for milk are ordinarily given crop residues consisting mainly of wheat and rice straw, *juar* (sorghum) stalks, the husks of certain grains with a little oil-cake and cotton seed where and when that is available. But the amount of these crop residues is very small as compared with the number of mouths to be fed, with the result that his cattle have to subsist from December till July, *i.e.*, throughout the dry season, on a ration which falls far short of the maintenance standard. During this period they undergo a period of semi-starvation and lose condition in consequence. In the neighbourhood of forests open for grazing the position is somewhat better, but not much; there, too, the pasture is burnt up when most required. For cows in calf this treatment is particularly detrimental; with the mother in a run-down condition the calf suffers for want of nourishment both before and after birth.

The remedies commonly suggested for this state of affairs are to throw open larger forest areas, including reserved forests for grazing, and to increase the area set apart for this purpose in villages too. With regard to the first of these remedies, I need only say that it would not go far to solve the fodder problem, even if Government were prepared to sacrifice its forests, in the interest of cattle-owners; for owing to climatic conditions the grasses in the forests, like those in village grazing areas, get burnt up in the dry season and lose much of their nutritive value. The great bulk of the villages in India are, moreover, so far distant from forest lands, that the villagers cannot conveniently send their cattle there for grazing. The advocates of the second remedy aver that within the last half century cattle have deteriorated owing to the reduction of village grazing areas. They forget, however, that within that period peace and comparative plenty have fostered an enormous increase in the human population, both in towns and villages and that this ever-increasing population must be fed. But even if it were feasible to increase grazing areas at the expense of cultivated land, that would not go far to solve the fodder problem; for during the dry season of the year village grazing lands do not provide pasturage worthy of the name. In the past when large grazing areas were available, the cultivator relied almost entirely on Nature to provide food in the form of pasture for his cattle. To this improvidence we mainly attribute the inferiority of the ryots' cattle in this country. The increase in population and reduction in the area of pasture lands have given rise to rural problems which are new to him, and he is only beginning to re-adjust his system of farming to meet the new conditions which face him. In some parts of India it cannot be said that even a beginning has yet been made; but in the more advanced provinces where grazing areas have been reduced to a minimum, fodder crops are being grown and cattle are

being stall-fed. In these provinces the cultivators realize that any increase in the grazing area at the expense of that suitable for cultivation would merely encourage cattle-owners to keep larger numbers of useless cattle, and that this would increase still further the pressure on food supplies. It is a fact that in the more backward parts of India where grazing areas are large, no provision is yet made for growing or storing fodders; and thousands of cattle are kept for no other purpose than to produce dung, the annual value of which is reckoned to be about Re. 1 or at most Rs. 2 for each animal. The existence of large grazing areas is, in short, one of the factors which retard progress in animal husbandry in India to-day. It is in the direction of tillage that scientific and economic advances are possible; for tillage unites the two great branches of farming, namely, bread production and live-stock rearing.

Cattle rearing over the greater part of rural India is thus handicapped, to a great extent, by the fact that there is not enough fodder produced in the average village to meet the annual requirements of the animals kept therein. Further, cattle-owners do not carry over the surplus available at the end of the rains—for use from December till July when grazing areas are parched and bare. There is besides no carry-over from one year to another, with the result that in years of short rainfall the fodder problem becomes acute. The Agricultural Department has of late years given much attention for that reason, to the question both of growing and storing fodders. Several very promising fodders have been introduced and methods of storing them in the dry state and as ensilage have been adopted on Government farms throughout the country. It has been definitely proved, moreover, that good palatable ensilage can be made from coarse grasses, weeds and other herbage which in most parts of India are available in considerable quantities towards the end of the rains. Crops such as maize and *juar* cut and siloed when in flower also make excellent ensilage as experience has shown.

There are definite types of silos in use on Government farms and on the military dairy farms in India; but they may be divided roughly into two classes, *viz.*, (1) *pucca* and (2) *kutch*a silos. The former are, perhaps, too expensive except for the well-to-do landowner. The *kutch*a silo, on the other hand, which consists merely of a pit in which the fodder is stored in the green state and covered with a thick layer of earth, costs very little, and is well within the means of the ordinary ryot. Such silos are in use on many Government farms in this country. At the Imperial Cattle-Breeding Farm at Karnal pits dug in the heavy alluvium soil and filled four years ago with green *juar* were opened last cold weather: the ensilage at the end of four years was found perfectly sweet and good. This method of storing fodder in the green state, when it is abundant and not required for immediate use, should in course of time commend itself to the more enterprising agriculturists of this country. It is a method which,

if adopted by stock-owners, would enable them to provide their cattle with a luscious food in the dry weather when grazing areas are parched and bare.

What, it may be asked, can the Imperial and the Provincial Departments of Agriculture do to popularize the use of ensilage as a cattle food? They can and are doing much by example and precept; ensilage is now being made on Government farms and cultivators are encouraged to visit these farms and to study the process of ensilage making. In some provinces lectures illustrated by magic lantern slides are being given. A very excellent cinema film illustrating in detail the processes involved in making ensilage in *kutch* pits has been prepared at Pusa and will, we hope, be available for use in the provinces. By carrying on propaganda on these lines it should, in the course of the next 20 years, be possible to effect considerable improvement both in the production and storage of fodders in this country; but the apathy of India's landowners towards agricultural development generally will first have to be broken down. Until this is accomplished, animal husbandry will continue to suffer neglect, and the high standard of cattle-breeding and cattle-feeding aimed at on Government farms will be of little avail. But to bemoan our difficulties will not remove them: we must look for a remedy. This apathy can be dispelled only by giving the sons of the landowners a more scientific and practical education. The type of literary education given them in the past has alienated their sympathies from agricultural pursuits. Realizing this, Government has within the last two decades evolved a system of agricultural education based on science and practice. The indications are that this type of education, as provided for at our provincial agricultural colleges and the Imperial Institute of Animal Husbandry and Dairying at Bangalore, will go far to foster a real practical interest in animal husbandry and dairying in this country. The men trained at these institutions will, we trust, in course of time aspire to do for animal husbandry in India what the gentlemen farmers of England have done for it in that country which is now regarded as "the stud farm of the world".—*The Agricultural Journal of India*, Vol. XX, Part VI, p. 449.

The Progress of Economic Entomology in Australia and New Zealand.

II. *The Control of Noxious Weeds by Insects.

I turn now to the second type of problem mentioned at the beginning of the main part of my address—namely, that of control of noxious weeds by their insect enemies. Until quite recently this was almost a virgin field, as the only work that had been done along these lines was the control of lantana in the Hawaiian Islands by means of a lycaenid butterfly and a small fly. These insects attack the buds and the fruit of the weed, with the result that it was quickly prevented from further spreading: what was already there was grubbed out in very thorough fashion, except in inaccessible places, and the menace is now entirely removed. Those of you who know the hold that lantana has obtained along the east coast of Australia will agree that this achievement was in itself a notable one.

My predecessor in this chair, Professor T. Harvey Johnstone, of Adelaide, gave us for his presidential address at the combined Wellington meeting in 1923 the subject of control of prickly pear by means of its insect and fungus enemies. It is not my intention here to deal with this problem as fully as he did, but it is necessary that I should summarize for you the course of events, and should also bring the account up to date by including the very latest developments. For this purpose I have obtained from the Institute of Science and Industry in Melbourne through the courtesy of the Director, Sir G. H. Knibbs, a number of advance copies of the new Prickly Pear Bulletin, which gives a full report of the first five years' work of the Board. This report has been supplemented by letters from the retiring officer in charge, Mr. W. B. Alexander, and from the present officer in charge, Mr. L. F. Hitchcock, giving further details of progress made since the report was completed. Thanks to the courtesy of all these gentlemen, I am able to give you an account which brings this remarkable piece of scientific work right up to date.

In the early years of the work, before the method of control by insects was tried out, both chemists and inventors had a try at the problem. Various suggestions were made for the utilization of prickly pear commercially, but they all failed through the enormously high percentage of water in the plant, the small amount and poor quality of the fibre, and the very low fodder value. Then came the idea of a drastic mechanical attack on the pear—*e.g.*, by driving huge tanks at or through it, crushing

* Presidential Address to the Biology Section of the New Zealand Institute Science Congress, Dunedin, January 1926, by Dr. R. J. Tillyard, Cawthron Institute of Science Research, Nelson.

it into the ground, and automatically ploughing it in at the same time. This was also a failure. The chemists discovered certain arsenical compounds which would destroy the pear at a cost estimated to make the project a commercial success, and a company known as "Cactus Estates, Ltd.," was floated to deal with pear-infested land. This company took contracts to clear given areas of land at a quoted price per acre. I believe they lost money on every contract which they took: the cost of dealing with the pear was always higher than the contract price and in some cases approached very close to the actual value of the land itself per acre. Thus this very laudable effort failed also. Australia was then left in this desperate position: Here was a pest which already occupied an area of land in Queensland and northern New South Wales as big as the whole of Tasmania, and was increasing at the rate of a million acres a year! Unless some remedy were found, in less than a hundred years' time eastern Australia might consist of a wilderness of prickly pear and a series of walled cities fighting for their very existence against it! The vision of this dire calamity approaching was enough to overcome even the prejudice against the use of insect enemies, and so entomologists were sent abroad to all the cactus lands in America to find enemies of the pest and bring them into Australia.

The first point to notice is the method adopted to prevent any possibility of damage being done to plants of economic value by the introduction of these insects. Permits were only granted for introduction into approved research stations, where the insects had to be bred in closed insectaria and cages. At the same time tests were to be carried out with each insect on as many plants of economic value as possible, with a view to finding out whether they would attack anything besides prickly pear. It is interesting to note that out of more than thirty insects introduced not a single one has yet been found which would eat anything else besides prickly pear, while a large number of them will only attack certain species and varieties of the prickly pear, leaving others quite unharmed.

I wish to emphasize the details of this work here, because it has a very important bearing on a problem of the greatest moment to New Zealand—namely, the control of blackberry. As there is to be a separate discussion on the subject of the blackberry pest I will not deal with it fully here.

The second point which I wish to emphasize is one that is often overlooked. Plants and insects have been evolving together for countless ages, and their interactions one with another are very complex, showing all degrees of specialization. The fossil record shows us that these relationships were much the same three million years ago as they are at the present day. In other words, the insects reached the zenith of their evolution long before mankind came on the scene. This condition

of equilibrium between plant and insect life can be, and often is, upset by man in pursuit of his own schemes ; but it is not generally realized that every change that has been brought about by this means has been actually within the power of man to grant or to withhold. It is only ignorance or lack of care on man's part which gives the insect its opportunity to become a pest. I cannot give a better example of this than the famous case of the gipsy-moth, *Porthetria dispar*. This moth was a native of Central Europe, and was known to have been the cause of serious damage to various forest, orchard and shade trees, especially in Germany. Nevertheless, because of its fine silken cocoon, which possessed a possible commercial value, it was deliberately introduced into Massachusetts in 1869 by a French scientist whose intention was to establish a silk industry with it, using it in captivity only. The moth, however, was allowed to escape through carelessness. Let it be said to his credit that the scientist at once advertised the fact by every means in his power, pointed out the dangerous character of the insect, and implored the State Legislature to take action against it. Entomology "cut no ice" at all, even in America, in 1869 and people took no notice of the warnings. A few years later the good folk of Boston began to notice marked defoliation of their beautiful trees, and it was found that this moth was spreading far and wide, carrying destruction in its wake. In spite of millions of dollars which have been spent in the effort to check the pest it is still spreading, and has recently reached Canada and New York State.

In Europe the gipsy-moth feeds on a variety of trees and shrubs, such as oak, apple, willow, etc., but pines of all kinds are entirely immune from it. In America the same thing occurs. Pines, both native and introduced, are immune, and the moth confines its attention to the introduced hosts on which it originally fed, and to those American species which are closely related to them, such as pin-oak, red-oak, maple, etc. Now, this moth is one of the most generalized feeders known ; the female lays its eggs almost anywhere, and at no stage of the life-history does there appear any tendency to restriction of diet. Yet under the new conditions the immunity of pines from attack held good.

The lesson we can learn from this is that in dealing with an insect we are dealing with a stabilized type. If we know its habits under natural conditions we can be fairly sure of its behaviour under any new set of conditions. If we introduced the gipsy-moth into New Zealand we could state with certainty that it would not touch any of our introduced or native pines or taxads and we could with equal certainty name all the introduced trees which it would attack, and also those native trees which it would most probably attack too.

Nevertheless it is right that we should insist, as biologists, that in every case of the introduction of a plant-feeding insect very thorough

experiments should be carried on to determine the exact limits of its feeding-capacity before any attempt is made to utilize such an insect in the open.

Now, to come back to the prickly pear problem, the method adopted by the Australian scientists in testing their insects is that known as the starvation-test method. It is well known that every organism struggles to go on living, and searches eagerly for the food necessary for it to live. Any insect will attempt to eat unaccustomed food rather than starve to death, if it can possibly do so. A brood of larvæ, therefore, is taken and divided into two equal parts ; one of these is put into a cage in which there is a supply of prickly pear, and the other into a cage in which the only food supplied is the plant to be tested—say, pumpkin. The relative behaviour of the two lots of larvæ can then be noted. Both will rest until the time comes for them to feed. Then those on prickly pear will go ahead, while those on the other plant, urged on by an equal desire for food, will wander over the unaccustomed plant searching for their normal food. As hunger increases they must do one of three things : (1) They may feed on the new plant, find it digestible, and continue to feed and grow on it ; (2) they may eat the new plant, find it indigestible, and turn sickly, finally dying of indigestion or starvation ; (3) they may absolutely refuse to touch the new plant, dying straight out from starvation.

Other things being equal, it is found that young larvæ are less likely to attack a new plant than older larvæ. The latter, having much stronger jaws, will sometimes, driven by hunger, eat into an unpalatable plant in the vain attempt to obtain sustenance from it before dying of indigestion or starvation ; whereas in young larvæ the inherited instinct is usually so strong that they refuse to touch the new plant, even if their jaws are strong enough to gnaw it or to pierce it. In the case of the prickly pear insects a few of the older larvæ made slight attempts to eat unaccustomed plants, but the effects were very soon visible in the form of severe indigestion, followed by death.

The first insect introduced into Australia was the cochineal insect, *Dactylopius indicus*. This, soon after it was liberated, entirely destroyed some thousands of acres of one species of prickly pear, *Opuntia monacantha*, but was quite ineffective against the commonest pest pear, *Opuntia inermis*, and the other species present in Australia. A search was therefore made for other species of *Dactylopius*, and several of these were introduced and tested. One of these, *D. tomentosus*, showed such good results on *Opuntia inermis* in captivity that it was the first of the new lot on insects to be liberated in 1923. This insect is now doing wonderful work in the field, both in Queensland and New South Wales. The Governor of Queensland, Sir Matthew Nathan, was so impressed with the results in the Blackall district that he suggested that this insect should be

distributed by the train-load ! A permanent staff is now engaged in packing and distributing this insect to all parts of Queensland where prickly pear exists. There are already numerous places where, instead of the impenetrable thicket of prickly pear that has existed for the past twenty or thirty years or more the work of this tiny little insect in the course of only a year or so has opened the thicket up sufficiently for men to get through it with ease ; in other cases, where the insect has been at work longer, a team of horses can be driven over the ground ; and in a few cases the pear has been entirely cleared and the ground put into cultivation.

A curious point about this insect is that it is impossible to predict in what areas it will succeed and in what areas it will fail. Apparently in some places the pear is too tough for its tiny beak to penetrate, and there it fails to do any good. In some areas it attacks the pear equally well both in scrub and in the open, while in other areas it cannot get a start on either. It is generally admitted now, after seeing its work during the last two or three years, that this insect will be one of the main factors in cleaning the pear from very large areas in both States.

No other insect has been liberated as yet for so long a time as *Dactylopius tomentosus*. The next most effective species appears to be the red mite, *Tetranychus opuntiae*, which has only been liberated quite recently in three or four areas. A. P. Dodd, who has recently been promoted to the position of officer in charge of the investigations, considers this the most destructive enemy of prickly pear known so far.

The large coreid bug, *Chelinidæ tabulata*, which I saw in immense numbers in the cages at Sherwood in 1923, is a most formidable insect which looks at first sight much too dangerous to be liberated in any country. It was tested out, I believe, on no less than seventy-eight plants of economic importance before permission was given to liberate it. It confines itself entirely to the genus *Opuntia*, and increases at an incredible rate. Its attacks make the plants sickly and greatly reduce the amount of fruit produced. Though it is a far more spectacular insect than the cochineal it never seems to produce fatal results. It is now being spread in all directions throughout Queensland and many of those who have observed its work consider that it will be one of the main factors in the subjugation of the pear.

Two other species of *Chelinidæ* and one of the *Narnia* were also brought into Australia, but failed to increase in captivity to any extent. They have not been liberated.

Of caterpillars which feed on cactus, species of *Melitara*, *Mimorista*, and *Cactoblastis* have been experimented with. Only two have so far been liberated—namely, *Melitara junctolineella* and *Mimorista flavidissimalis*. The former is spreading rapidly, but its effect in reducing the pear

is not very great. The latter increased well at first, but none has so far been seen this summer. One of the latest introductions is the moth, *Cactoblastis cactorum*, from the Argentine. In captivity this has proved much more destructive than any species of *Melitara*, and also it is a much hardier species and easier to breed in confinement. It has increased at a prodigious rate, and liberations are about to begin. Judging by its effect in captivity this insect, when liberated, should rapidly become one of the leading agents in the destruction of the pest.

Some large longicorn beetles of the genus *Moneilema* were introduced, but were found to be difficult to rear in captivity. Later on it was discovered that an egg-parasite had been introduced with them. This insect had to be eliminated and a fresh start made. Up to the present these beetles have not increased sufficiently to enable liberations to be made. The flightless weevil, *Gerstaeckeria basalis*, has also been acclimatized in cages, but not yet liberated. Several other species of beetles have been introduced, but failed to become acclimatized.

It is of special interest to note that so far, only one enemy has made its appearance in the field, and that is our old friend *Cryptolæmus montrouzieri*, the ladybird beetle which is a well-known enemy of mealy bug. This insect has been attacking the cochineal insects, but, so far as at present can be ascertained, the cochineal increased at a much greater rate than the ladybird, and the latter has had no appreciable effect on it.

In a newly published bulletin on the Natural Enemies of Prickly Pear accounts are also given of a number of fungus diseases and a bacterium which are being experimented with. None of these has so far been liberated. Unlike the insects, the bacterium, *Bacillus cacticidus*, when tested on other economic plants was found to produce a very serious disease in squashes, melons, and marrows. The fungus, *Glæosporium venetum*, caused a rot to develop in apples within twenty-four hours. Two other species of *Glæosporium*, one of *Hendersonia*, one of *Macrophoma*, and one of *Macrosporium* have been tested without causing injury to any economic plants. None of these, however, has as yet been liberated, and it is unlikely that they will play any effective part in the control of the pest in future.

The general opinion at the present time in Australia is that the problem is in course of solution by the utilization of the insect enemies alone. A few years back the then Minister for Lands in New South Wales, visiting the prickly pear laboratory in the north-west of that State and seeing the work that was beginning there with the insects, remarked that it was the one bright spot in an otherwise hopeless situation. In 1925 the officer in charge of the principal laboratory in Queensland was able to write as follows: "There is now no doubt at all, in our opinion, that

in time, by biological means, we shall surely control the prickly pear pest in Australia."

Prickly pear has laid waste more land than any other pest plant in any part of the world. Its subjugation appeared a hopeless task until the leaders of thought in Australia took courage and decided to utilize the insect enemies to control it. The cost of the work to date has been £40,000 and the total cost before Australia is freed from pear may well amount up to £100,000. The area of land infected is approaching thirty million acres, and is increasing at the rate of one million acres a year. Even if we place a very low average value on this land—say, £10 per acre—there are three hundred million pounds of capital locked up in the infested land and a further ten million pounds worth going out of action every year. To rescue three hundred million pounds worth of land in the course of ten or even twenty years at a cost of £100,000 would be a wonderful achievement from whatever angle you may choose to view it, and if it is done by means of the insects, as it appears at present that it will be done, entomologists will be able to claim to their credit one of the greatest triumphs of the human race.

The control of plant pests is one of the outstanding problems of the present day, and one of the most difficult. A plant which to-day is a mere curiosity of which nobody takes any notice may in ten years' time be a pest, and in twenty years' time a menace to the life of a whole community. In Victoria the St. John's wort, *Hypericum perforatum*, has seized and occupied an entire valley of previously fertile country eighty miles in length. In New Zealand and in Australia alike blackberry is spreading at an alarming rate. Who shall say what will be the worst pests of the future! Why should we tolerate any weed in our midst if science can find a simple way of removing it? Therefore I conclude this address by commending to you all the careful study of the problem of control of plant pests by their natural enemies, and appeal to you not to let fear or prejudice sway you in making a decision on so vital a matter. The advance of entomology as an exact science during the past few years has been phenomenal, and our knowledge is now sufficiently sound and wide to justify us in stating that we are capable of undertaking the study of the control of any plant pest by means of its insect enemies without allowing the slightest possible chance of any damage accruing to our country. All we need is the necessary well-equipped laboratories and insectaria, and enough trained entomologists and assistants to do the work required. In the course of a year or two of work in the insectarium we can discover without any shadow of doubt what any given insect will do if it were to be liberated in New Zealand. Where a safe remedy can be found against any plant pest in the form of an insect which will attack it without touching any other plant, then it should seem to be a clear duty

on the part of those responsible for the welfare of the country to accept the decision of its scientists and encourage the work to go forward.

I am well aware that in the case of prickly pear the pest plant was of such a specialized nature that the chances of its insect enemies attacking other plants as well were reduced to a minimum. In the case of blackberry or St. John's wort this would not be so. The scientist's duty then would be to test out all likely insect enemies in the insectarium, to eliminate at once those which attacked other valuable economic plants, and to continue to work with those which would not attack them. In the case of a very serious pest such as blackberry the final result might be a good chance of control, with risk to one or two related plants such as raspberry and loganberry. In such a case if the prospective gain were enormous beside prospective loss, or if means could be found to prevent the loss, it would be our duty, in my opinion, to press forward with the work and to check the spread of destructive pest weeds over larger and larger areas of this fair country of ours.—*The New Zealand Journal of Agriculture*, Vol. XXXII, No. 4.

Ninth Annual Report of the Mysore Agricultural and Experimental Union.

It gives me much pleasure to welcome you to the Ninth Annual Meeting of the Mysore Agricultural and Experimental Union and to submit the report for the year 1926.

The Mysore Agricultural and Experimental Union is the outcome of a common desire on the part of the ex-students of our Agricultural School, Officers of the Agricultural Department and the leading agriculturists of the State to come together for a common purpose, *viz.*, the advancement of the State's agriculture.

Trials of suggested improvements on the fields of members in the various parts of the State have formed the main item of our programme during these nine years. This has provided a sort of research work for our members on their own lands. It has taught them that they themselves have an important part to play in working out their problems, *viz.*, that of determining for themselves the suitability or otherwise of various suggested improvements under their own local conditions.

The programme of the Union's work has included practically all the branches of the Department's activities. The following items of work are being carried out annually since its inception in 1918:—

1. Trial of improved implements.
2. Trial of improved strains of seed of important crops.
3. Trials of manures.

4. Trials of methods of control against insect pests and fungus diseases.
5. Ensilage making.
6. Maintenance of Farm Accounts.

During the year 1925, 38 members undertook experimental work as detailed in the following statement. (*Vide* Statement I.) Thirteen members had undertaken to conduct trials of implements. They were informed that these trials should be conducted with the implements owned by them. Not one report of any trial has been received. There seems to be an impression that a trial need be conducted only if the Agricultural Department sends out implements for trial. It does not seem to have been realized that even with regard to the implements, indigenous and imported, which are already in use in the State, correct statistics as regards their work are not available and that these statistics could be made available if members take a little interest.

As regards trials of sugarcane varieties, seed sets could not be supplied for experiment. Manurial experiments on sugarcane and paddy were undertaken by seven members but manure could not be supplied free for trial and the experiments were not conducted.

Due to adverse seasonal conditions a large number of ragi, groundnut and castor varietal tests failed but even in the case of a few experiments which were otherwise conducted properly, results were not collected with care. Three members have reported results and the results are tabulated below:—

Report on Ragi varietal tests by Mr. C. T. Reed, Whitefield.

Variety	Calculated yield in seers per acre	Remarks
C514	135	} Crop poor due to shortage of rainfall.
C688	198	
C689	250	
H 77	265	
H 22	202	

Trial by Mr. G. Sivappa, Davangere.

Local	560 seers	H22 is later than the others by a fortnight but is suitable for early sowing. Grains do not shed even if there is a shower at harvest time. Gives fair crop even in poor soils.
C688	603 "	
H 22	640 "	
C689	652 "	C688 comes to harvest about the same time as local and gives more straw also than the local variety. The crop matures uniformly unlike the local. C689 is better than C688 but the straw is very brittle and crumbles during threshing. I am growing H22 and C688 on a field scale this year, <i>i.e.</i> , 1926.

Trial by Mr. G. Ramaswamy Naidu, Chintamani.

Ragi	C688	27½ seers	}	Yields are not calculated per acre as the exact dimension of plots has not been reported.
"	C689	24 "		
"	C514	25¼ "		
"	H 77	28 "		
Castor	H6	32 "		
"	H7	31¼ "		
Groundnuts—				
	Sugatoo	65 "		
	Transvaal	75 "		

Besides these, one of our members, Mr. H. Krishnappa of Chintamani, has sent in an account of work done on his farm. This relates in no sense to any definite experiments conducted by him and no conclusions of value can be deduced from them. Mr. G. Narasimha Iyengar of Amrutur is another member who has been conducting trials for a number of years. Such individual efforts as these on the part of our members to collect statistics of farming costs and profits indicate what scope there is for organizing our experimental work so that results of value may be obtained where now for want of knowledge so much effort is misdirected.

During the present year 20 members have undertaken work, *i.e.*, about half of the number of members who

undertook work in 1925. Reports of results are not available yet. The following statement gives the names of members and the work undertaken by them. (*Vide* Statement II.)

It must be stated however that the work has not developed as rapidly as might be desired. We have on our roll 225 non-official members. But the number of members who have undertaken work in any one year has not exceeded 41 members and it happens also that in many cases the same members undertake work year after year. (Statement III gives details of work undertaken during the 5-year period 1922-1926.)

During these nine years, material enough for more than 400 trials has been supplied by the Agricultural Department. But not more than some twenty* reliable results are available. Either the experiment has not been properly laid out or when properly laid out, results are not properly collected or when both these have been done, the experiment has not been carried out for more than one season so as to eliminate errors due to climatic influences. But the fact has been demonstrated that, given the proper knowledge and assistance, the Mysore farmer can be trained up to equal the German or the American farmer even in this experimental work.

Co-operative experiments form an important part of the work of agricultural departments and colleges in all the agriculturally progressive countries of the world. The work goes under various names such as Agricultural Extension, Farmers' Experimental Plots, Co-operative Experiments, Circles for Agricultural Experiments and so on. It may therefore be profitable for us in Mysore to know something about this world movement in order that our efforts may be organized in the best way possible.

One of the earliest organizations started with the view of enlisting the co-operation of farmers in experimental work is the Ontario Agricultural and Experimental Union

in Canada. This Union was started forty years ago, in 1886, and co-operative experiments have been carried out by its members steadily since then. In Field Husbandry alone more than 1,10,000 co-operative tests have been conducted throughout Ontario, or an average of 2,691 per annum for the 40-year period. During 1925, there were 2,832 farmer-experimenters. This relates to the Province of Ontario alone and not to the whole of Canada.

Extension work which includes co-operative experiments is thoroughly organized in the United States. Farmers' experimental plots are a feature of Australian agriculture.

While Germany is far advanced in the application of science to Agriculture it is surprising that efforts to enlist the co-operation of farmers for its extension work are being made only for the last three or four years. But the movement is gaining ground. The first "Experimental Circle" was started in 1922 in East Prussia. During the early part of 1925, already 80 circles had been formed, the total area covered by these circles being nearly 3,24,000 acres or five per cent of the total cultivated area of the province. The movement is spreading to the other provinces of Germany also.

We may now consider briefly some details as regards the organization of work in two of the typical countries—Ontario and Germany.

The Ontario Union like our Union has on its programme experimental work on almost all the improvements recommended by the Ontario Agricultural College and the Department of Agriculture. The Ontario Union has a General Committee such as we have. It has also Committees responsible for organizing and carrying out experimental work. There are nine such committees each of which is responsible for the subject entrusted to it. There is a Committee for Field Husbandry with the head of that section as Director of the Committee. There is a Committee

for Agricultural Botany with the Botanist as the Director. There are Committees for Forestry, Agricultural Chemistry, Agricultural Physics, Animal Husbandry, and so on. The Director of each of the Committees, *i.e.*, the Chairman, is the officer in charge of the subject in the College and he is assisted by a few selected farmers on the Committee. Each of these committees not only makes arrangements for the work entrusted to it but also supervises it while it is being carried out. Thus, each small experiment has the benefit of expert guidance and supervision, and there is every chance for a trial being carried to a successful conclusion.

Let us now turn to Prussia in Germany which has been rapidly developing its extension work. Prussia has a Central Body called the "Chamber of Agriculture of the Province of East Prussia". The various Experiment Circles work along general lines laid down by the Central Body (which is really a "Union of Experimental Circles") but modified with reference to local conditions. Every circle has an experiment leader. Regular salaries are provided for the experiment leaders and the circles guarantee them free board and lodging on one of the farms. The leader's work consists in planning and carrying out field experiments on the farms of the co-operating members. His work does not stop with advising but it is his duty to see that the work is properly planned and successfully carried out. It is unnecessary to dilate on how the work is done in other countries, Ontario and Prussia being sufficiently typical.

Our methods of work may now be briefly stated :—

The programme of work is drawn up by the Agricultural Department. Members are circularized as regards the work for the year and invited to undertake some part in it. They undertake such work on the programme that they are interested in. The Secretary arranges with the Department as regards the materials required, such, as improved seed, manure, etc. The

Department sends the material and the Union sends printed instructions as to how the trials have to be conducted. In a few instances help is given to the experimenter as regards laying out the plots for experiment. Blank forms are supplied to report the results on.

There are obvious difficulties in the way of work being organized as efficiently or on as large a scale in Mysore as in Ontario or Germany. We have no doubt a certain number of leading agriculturists who are residing on their farms and who are therefore in a position to undertake work. But most of them lack the knowledge which is essential for the proper conduct of experimental work. No amount of literature can give that knowledge better than a personal direction on the spot by fully qualified persons. It is the inadequacy of this personal touch which seems to be responsible for the very slow progress of work here.

PART II.

Journals of the Union.

The Kannada edition of the Journal has been discontinued since 1923 due to our meagre finances. It has not been possible to obtain more than the usual subvention from Government. The English edition of the Journal is very much in arrears due, as was stated in the last report, to inadequate contributions. The following numbers were issued since the last annual meeting :—

Vol. VII, No. 2 on '3-12-25.

Vol. VII, No. 3 on 6- 5-26.

Vol. VII, No. 4 on 22-11-26.

Vol. VIII, No. 1, *i.e.*, the first issue for 1926, is in the Press and may issue before the end of the month. The edition pays its printing expenses and if it could be issued regularly there seems no doubt that circulation will increase. The subject is on the programme of this meeting and therefore much need not be said on it here.

The following statement gives the abstract of receipts and expenditure for the year ending with 31st October 1926:—

Receipts	Amount	Expenditure	Amount
	Rs. A. P.		Rs. A. P.
Opening Balance	671 2 4	Establishment	776 0 0
Entrance fee	33 0 0	Postage	15 8 0
Annual fee	185 7 0	Expenses Annual Meeting, etc.	197 11 9
Journal Subscription ..	71 0 0		989 3 9
Annual Meeting Subscription	131 0 0	Cash on hand	124 10 7
Miscellaneous	22 5 0		
Total ..	1,113 14 4	Total ..	1,113 14 4

The annual fee and subscription to the Journal for 1926 due from members and subscribers has yet mostly to be collected as the first issue of the Journal for 1926 is yet to issue. Subvention for 1926-27 has been drawn since 31st October and payments made to the Press. The following statement gives a forecast of our financial position.

Receipts	Amount	Expenditure	Amount
	Rs. A. P.		Rs. A. P.
Annual fee or subscription for 1926 to be collected including arrears, if fully collected	750 0 0	Payment made to the Press since 31st October 1926	396 5 0
Half subvention sanctioned for 1926-27	500 0 0	Press bills pending payment	112 0 0
Advertisement charges ..	75 0 0	Printing charges of four English Journals for 1926 with postage thereon ..	603 11 0
		Establishment charges to the end of the year 1926 ..	213 0 0
Total ..	1,325 0 0	Total ..	1,325 0 0

It will therefore be clear that provided contributions are forthcoming, the finances permit us to issue the four numbers now in arrears.

STATEMENT I.

Serial No.	Name of Member	Experiments undertaken during 1925
1	Mr. A. V. Kuppuswamy Mudaliar ..	Ragi, Paddy, Paddy manure and Farm Accounts.
2	" T. Narasinga Rao ..	Spraying for Coffee Koleroga.
3	" N. Amrit ..	Implements, Ragi, Groundnut, Paddy, Sunflower Ensilage, Rearing of Silkworms and Reeling.
4	" R. Herasingh ..	Implements, Ragi, Groundnut, Paddy, Sugarcane, Paddy manure, Sunflower Ensilage and Spraying for Diseases of Chrysanthemums.
5	" B. Abdur Rahaman ..	Sugarcane.
6	" S. Rajagopala Iyengar ..	Groundnut, Castor, Sugarcane, Cane manure, Paddy manure and Farm Accounts.
7	" A. Ramaswamy Iyer ..	Paddy manure.
8	" M. Subba Rao ..	Ragi, Castor, Paddy manure and Sunflower Ensilage.
9	" G. Ramaswamy Naidu ..	Ragi, Groundnut, Castor, Reeling, Rearing of Silkworms and Farm Accounts.

10	"	T. V. Krishnaswamy Iyengar	..	Ragi, Groundnut, Castor, Cotton, Sugarcane Borer and Pests of Stored Pulses.
11	"	K. Nagappayya	..	Paddy, Sugarcane, Paddy manure, Sugarcane Borer, Sunflower Ensilage and Farm Accounts.
12	"	Fazil Khan	..	Paddy.
13	"	A. Narasimhachar	..	Implements, Ragi, Groundnut, Castor, Paddy and Sugarcane.
14	"	B. Nagabhatta	..	Sunflower Ensilage.
15	"	B. Krishna Murthy	..	Implements.
16	"	Gowda Sivappa	..	Ragi and Groundnut.
17	"	G. Narasimha Iyengar	..	Paddy and Paddy manure.
18	"	B. Narasinga Rao	..	Implements, Ragi, Rearing of Silkworms and Reeling.
19	"	Munisamy Gowda	..	Implements, Ragi, Groundnut, Paddy, Sugarcane, Ensilage making, Rearing of Silkworms and Reeling.
20	"	R. Soorappa	..	Groundnut, Paddy, Paddy manure and Farm Accounts.
21	"	H. V. Rama Rao	..	Ragi, Paddy, Paddy manure, Sunflower Ensilage, Rearing of Silkworms, Reeling and Farm Accounts.
22	"	L. Narasinga Rao	..	Implements, Sugarcane and Sunflower Ensilage.

STATEMENT I.—(Concl'd.)

Serial No.	Name of Member	Experiments undertaken during 1925
23	Mr. A. M. Ramachandraiya	.. Implements, Ragi, Groundnut, Castor and Farm Accounts.
24	„ L. Krishnamurthy Naidu	.. Ragi, Groundnut, Castor, Paddy, Rearing of Silkworms and Reeling.
25	„ Y. Venkataramana Setty	.. Implements.
26	„ H. R. Guruvareddy	.. Implements, Ragi, Paddy, Paddy manure and Sunflower Ensilage.
27	„ H. Subba Rao	.. Castor.
28	„ Mohammed Mastan Baig	.. Implements, Groundnut and Castor.
29	„ S. C. Malliah	.. Implements, Ragi, Groundnut, Castor and Paddy
30	„ M. S. Veerappa	.. Ragi, Groundnut and Sunflower Ensilage.
31	„ Capt. C. T. Reed	.. Ragi.
32	„ G. T. Venkatachar	.. Paddy manure.
33	„ L. Balavantha Rao Uchagaoker	.. Castor.

34	„	M. V. Ramalingam Chetty	..	Ragi, Groundnut and Castor.
35	„	H. Subbanna	..	Groundnut and Cotton varieties.
36	„	B. Bashyam Iyengar ..	..	Ragi, Groundnut and Castor.
37	„	S. Hampaiya	..	Ragi.

STATEMENT II.

Serial No.	Name of Member	Experiments undertaken during 1926
1	Mr. M. V. Ramalingam Chetty	Ragi, Castor, Doddahatti, Sannahatti, Paddy and Sugarcane, Sunflower Ensilage.
2	" H. R. Guruvareddy	..
3	" R. Herasingh	..
4	" M. Srinivasa Iyengar	..
5	" A. S. Krishnaswamy	..
6	" A. Narasimhachar	..
7	" M. S. Veerappa	..
8	" G. Ramaswami Naidu	..
9	" M. Venkata Rao	..

10	Y. Ramachandra Rao	..	Sugarcane manure.
11	T. Narasinga Rao	..	Spraying for Coffee Koleroga.
12	L. Narasinga Rao	..	Ragi, Groundnut, Castor, Paddy and Sugarcane.
13	B. Nanjundiah	..	Sugarcane and Sunflower Ensilage.
14	B. Narasinga Rao	..	Implements, Ragi, Castor, Sunflower Ensilage and Farm Accounts.
15	M. Munisamy Gowda	..	Ragi, Groundnut, Doddahatti, Sannahatti, Paddy, Sugarcane, Cane manure, Pests of Stored Pulses and Rearing of Silkworms.
16	H. Krishnappa	..	Ragi, Groundnut, Paddy, Sugarcane, Cane manure, Paddy manure and Farm Accounts.
17	M. S. Ramachandra Rao	..	Paddy and Sugarcane.
18	M. Vasudeva Sastry	..	Paddy, Sugarcane, Cane Borer, and Pests of Stored Pulses.
19	D. Jaya Rao	..	Implements, Ragi, Castor, Paddy, Paddy manure, Sunflower Ensilage and Farm Accounts.
20	H. Srinivasa Rao	..	Groundnut and Cane manure.

STATEMENT III.

Details of Work undertaken by members during the five-year period 1922-1926.

Year	No. of members on the roll	No. of members undertaking work	Trial of imple-ments	Trial of varieties of seed					Manurial experiments		Treatment against diseases				Sericultural experiments		Farm Accounts
				Ragi	G. Nut	Castor	Cotton	Paddy	Sugarcane	Cane Manure	Paddy Manure	Sugarcane Borer	Pests of stored pulses	Control of fungus di-seases	Sunflower Ensilage	Rearing	
1922 ..	282	41	20	15	20	8	..	5	12	..	..	..	..	..	..	..	..
1923 ..	301	37	2	18	19	12	6	..	14	7	6	5	5	1	14	7	3
1924 ..	227	26	9	16	12	8	3	8	4	6	8	1	1	3	10	7	6
1925 ..	219	38	13	20	18	13	2	12	9	1	11	2	1	2	10	6	6
1926 ..	215	20	5	12	9	7	3	11	12	4	4	2	2	1	7	3	2
TOTAL ..			49	81	78	48	14	36	51	18	29	10	9	7	41	23	17
																	19

Total No. of Experiments undertaken... ..530.